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## NAVY BOATS.

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### PART I.

The writer has freely employed information with regard to coast life-boats, derived from the publications of the U. S. Life-Saving Service; the Royal Life-Boat Institution of Great Britain; "Life-Boats, Projectiles, and other means for Saving Life," by the late R. B. Forbes; "The Life Boat," by Captain J. R. Ward, Chief Inspector of Royal Life-Boat Institution; "History of the Life-Boat and its Work," by Richard Lewis; and "Specifications for U. S. Life-Saving Stations and Surf Boats."

With regard to the use of life-boats aboard ship little has been written, and that by either landsmen or those unacquainted with the peculiar needs of a man-of-war. Still, the writer can claim to have developed but little that is new. It has been his effort to state the case plainly and justly, to form an unprejudiced opinion, and to bring out points of practical and direct application aboard ship. The temptation to touch on the general features of policy and organization has been irresistible; but once committed, their criticism has been actuated

by a sincere desire for improvement. Since the need of change has been recognized by the appointment of a "Board of Reorganization," many of these points will have already received attention.

It was only the other day that one of the editorials of a great engineering journal, in speaking of technical education, said: "Men, especially young men of the student's age, are not machines; they want some living interest to give them a zest for their work." In the same way, some fragment of discretionary action must be left every man aboard ship. The mind of a "blue-jacket," to make him fit for his place, must be made to work, as well as his muscles. The "points of isolated responsibility" aboard ship are far less *responsible* in drill than they will be in action—far less isolated than when it may cost one's life to go from one to another.

Give the young officer, the seaman, the apprentice, a chance to try himself; let him learn how to wield responsibility, not under the direction of his superior with all the authority of the ship at his back, but alone, when he must gain his point through the force of his own individuality, correct his own mistakes, and, in general terms, make a man of himself.

It is believed that there is no surer way to cultivate self-reliance and resolution in a modern man-of-war's crew than by boat drills at sea and frequent landing through the surf.

There is no space on a modern man-of-war allotted to sentiment; qualities must be limited by *existing* essentials rather than precedents, no matter how honorable and efficient they may have been in another day and generation. Changes based on necessity must continue to be made so long as there is a navy; they are not a reflection on the customs of the past. Each generation has its own advance to make.

Apart from sails and spars, there is, perhaps, no adjunct of the old-time man-of-war around which tradition lingers more fondly or about which a sailor's proper pride is more exacting than the boats. It may be said that the service would be anything but pleased by the substitution of new and safer types lacking some of the features that have characterized men-of-war boats for the past hundred years. They are swift and handsome. No one has watched them threading their way among the mongrel craft of a foreign port but he has felt a patriotic glow of satisfaction in their trim appearance. Their speed and grace is an old story the world around; not a ship in the navy but has its pet boat, not a blue-jacket but has reminiscences of racing triumphs.

And yet how many ships dare lower a boat in rough weather? How many wrecked crews have been saved by navy boats? That there have been such instances make them all the more remarkable for skill and courage. Instead of the exultation at their victory in the more peaceful contests, would it not be a nobler thing, more consistent with the purpose of a navy, if they were less feeble in their struggles with relentless winds and sea?

Is the present state of affairs to continue, when hundreds of lives have been lost in a few years past, in wrecks on coasts *where the stress of sea and surf yet permitted a few stray men to swim ashore?* The officer is lucky indeed who has not in some way been closely associated with or present at a fatal boat accident. The list of navy dead from this cause is growing stealthily but surely. On every coast, in the smooth harbor waters and in the booming surf, good men's lives have been paid as the price of an assumed military appearance and smooth-water speed in ship's boats.

There are those who will deny this: some minds leap to a stern judgment of all connected with disaster, no matter how defective experience, strength, and facilities may be. The truth is that the sphere of usefulness of navy boats has been so long and inflexibly limited by their defects, that many do not understand that there is a wider field for them. And here it may be said that in no other department of the respective experiences that go to make up the efficiency of different naval officers, is there a greater variety than in that of the handling of boats. The duty of "boat officer" is generally assigned to certain grades, and to some extent it is fair to suppose that the practical experience gained is proportional to the time spent in these grades. Of course there are many brilliant exceptions; boat duty is a very different thing on different stations and ships. For an entire cruise, it may be sometimes said that the boat officers are no more than sentries guarding the boat's crew against the enticing dangers of the beach, rather than from those of the harbor. No disparagement of this duty is intended; its necessity is lamented, but most junior officers will declare it to be one of the most instructive, if most unpleasant, lessons in the control of their men. Not much, however, is learned of the management of boats.

In bad weather, boat service is limited to the necessities of the occasion, not only because it is not desired to inflict hardship on officers and crew, but because the boats are known to be unfit for such work. So, however valuable the experience might become, the actual danger involved forbids the attempt to gain it.

Of all the branches of this encyclopedic profession, seamanship lies closest to the heart. It requires self-reliance, decision, and courage to deal with the grand forces of nature. The exhibition of ignorance or error in its practice, no matter how meager the experience or scant the opportunities of learning, is guarded against by many a young officer with anxious dread.

There is too much of this, for, in consequence, many stand in danger of blame for lacking practical knowledge which it has never been their opportunity to gain.

Before deciding that navy boats are of necessity fit only for smooth weather and light loads, the qualities essential to all-around seaworthiness should be analyzed, and the attempt made to combine their essentials in a boat able to perform routine work and be carried at a cruiser's davits.

No higher degree of seaworthiness can be found than in the heavier life-boats employed along some parts of our coast, and especially that of Norfolk and Suffolk in England, where it is necessary to go off under sail to reach outlying wrecks. Many of these boats are improved variations of the celebrated Beeching life-boat, the first self-righting boat ever built, and which won the prize of 100 guineas offered by the Duke of Northumberland in 1849, for the best model of a life-boat. This fact did not make them entirely safe, however, for two were lost through the shifting of water ballast while under great press of sail. The water ballast had leaked out of its well into the air compartments.

The report made by this committee of award is undoubtedly the best original publication on the subject of life-boats suited to the coasts of Great Britain. It has been largely drawn upon in this article. It must be borne in mind, however, that the coast with which this committee dealt is thickly peopled, and many willing hands may be found for manning and launching heavy boats. There are frequent harbors or shelters from which the boat can be pulled out to sea without launching through the surf, and in some parts it is even possible for a powerful tug to tow the life-boat to the vicinity of the wreck. Another point with regard to this report is that while the coast presents a great variety of aspects, and the duty of the life-boat will vary in character almost as much, the committee could give but one prize—to the best *all-around* competitor. This, of course, makes it more interesting to naval people, though the use of the boat from the shore as a base was alone considered. There

were 280 models and plans submitted; the Beeching boat received a mark of 84 out of a possible 100; the next two competitors, 78 and 77. Only 36 received over 60. It is apparent, therefore, how damaging this method of determining relative standing was to special or local merit, especially when it is known that many of the boats were built for localities where they are still used.

The values assigned the various qualities by this committee are as follows:

| | |
|---|---|
| Qualities as a rowing boat in all weathers | 20 |
| Qualities as a sailing boat | 18 |
| Qualities as a sea-boat as to stability, safety, buoyancy forward for launching through a surf, etc | 10 |
| Small internal capacity for water up to thwarts | 9 |
| Means of freeing boat of water readily | 8 |
| Extra buoyancy; its nature, amount, distribution, and mode of application | 7 |
| Power of self-righting | 6 |
| Suitableness for beaching | 4 |
| Room for, and power of carrying, passengers | 3 |
| Moderate weight for transport along shore | 3 |
| Protection from injury to the bottom | 3 |
| Ballast, as iron 1, water 2, cork 3 | 3 |
| Access to stem and stern | 3 |
| Timber heads for securing warps to | 2 |
| Fenders, life-lines, etc | 1 |
| | 100 |

Had the committee also been obliged to mark according to merit as a *ship's boat*, it is easy to see that no boat could be built *apparently* as efficient as the Beeching boat, through the introduction of limiting qualities of size and weight, and the high values assigned to them.

The late R. B. Forbes, an authority on the various appliances for life-saving, published a small volume in 1872 on life-boats.

He pointed out that, however fine a boat that of the R. L. Institution's was for the English coast, it was entirely too heavy and costly for the long uninhabited reaches of our open coast. Again, he notes that local customs must be respected if anything is to be accomplished; "seamen brought up on the coast have their own ideas as to the kind of vehicle they require when they are to risk their lives

to save life and property." For the New Jersey coast he recommends "a flat bottom, broad stern, sloping sided, cedar, or light corrugated iron boat, with considerable sheer. To possess detachable end air tanks, and a solid cork fender, fastened half way between the gunwale and the load-line. The latter will help when water has been shipped, will make capsizing difficult, and righting almost as much so. . . .

"If built of light wood, thirty feet long, eight feet wide, and three feet deep, it need not weigh over 1000 pounds. The chances are that a boat of this weight can be got off and on through a surf, the men being supplied with life-belts, when no boat called a life-boat, and deserving the name, could be manned and got off *on the Jersey coast by Jersey beachmen*. . . .

"The same may be said of the coast of Long Island. . . .

"At Nantucket, where the surf is heavy and the beaches frequently steep, the surfmen prefer light wooden clincher-built boats with large beam and considerable sheer, pulling long oars, single bank, and steering like whale-boats. . . . With end air cases and stout cork fenders, these boats will stand up with considerable water in them, and in case of being stove in they can be got ashore with some risk and difficulty. . . .

"Near Chatham and Orleans on the Cape shore, the surfmen use for their fishing and wrecking purposes full-built, flat, round-bottomed cedar-built boats, both ends alike.

"They naturally feel confidence in them, and will risk their lives in them when nothing would induce them to attempt to launch a life-boat weighing a ton only. . . .

"At Provincetown they have boats more like whale-boats, only with more beam, fair sheer, and very much shoaler than the Orleans boats—very light-built boats that pull five oars, and that can be picked up bodily by five or six men and run off to meet the rollers. It requires considerable urging to induce them to admit any extra buoyancy, or even to put on their belts. . . . At Cape Ann the seamen have nearly all been long accustomed to handling dories pulling short cross-handled oars, the largest pulling four and the rest two oars. A well managed dory will get off a rough beach dry when no other boat can. They are useful for saving life at times by carrying off a line, etc., but they are worthless for landing numbers of clumsy passengers."

Mr. Forbes further suggested a boat that would not antago-

nize the prejudices of the coast men, and for which he claimed durability, economy in the long run, and ability to command the confidence of the men who are to use them.

It is a "light corrugated iron boat, 25′ x 6½′ x 30″, with 15″ sheer; flat midship section, not very fine ends, centerboard, and to pull, at Nantucket, five oars single banked, elsewhere, six short oars double banked and one single at the bow thwart. The standing room should be, from sternpost becket to after thwart, about 8′. Much depends upon the steering oar, and it is important to have plenty of room to operate it freely. [Allowing 3′ between centers of 12″ thwarts, this would give foresheets of 4′ at Nantucket, and elsewhere, 7′ 6″.] Cork fenders along sides below oars, yet clear of water; on each side, under thwarts and close out to side, a cork float 12′ long, 12″ to 15″ in diameter, to assist in trimming and floating the boat if stove or filled; in the ends, air tanks or a mass of cork to *assist* in righting the boat. If the attempt is made to add any more extra buoyancy, the boat will be too heavy to launch and transport. Everything should be made detachable, so that if the boat be found too heavy, a part or all can be temporarily removed."

A sufficient abstract has been given to show that the *basis* of a combination of qualities desirable in a ship's boat has long been in existence.

Before attempting any original design it will be well to analyze these valuable qualities in the light of naval requirements and experience. It appears that all that has been written with regard to life-boats, except the circulars of a few interested inventors, assumes the shore to be the base of operations. Writers on seamanship apparently consider their task limited to instructions how to avoid being wrecked, for none of them attempt to discuss that last terrible evolution.

Other points being the same, a boat's seaworthiness increases with its size; however much, therefore, that of the ship may be deranged by considerations of speed and battery, the boat already has the odds against it, and if it is intended as a last refuge of safety, the seaworthiness should be considered above all other qualities.

From the report of the Life-Boat Committee appointed by the Duke of Northumberland, it appears that the most desirable proportions of a coast life-boat are:

"Length, 100; beam, 30, or for tideways, 25; sheer, $8\frac{1}{3}$, *i. e.* 1″ for each 1′ of length; weight, 1 cwt. for each 1′ of length; extra buoyancy, 1 ton for each 10′ of length. The internal capacity for water up to level of thwarts to equal the extra buoyancy.

Area of delivery valves to be one square inch to each cubic foot of internal capacity."

From other sources it is learned that the best stability of a parallelopiped is obtained when the *draft equals one-fifth the beam. The height of sides above water should be one-fourth the beam.* The best combination, therefore, for stability would be: *draft = three-twentieths beam; freeboard = four-twentieths beam.* That cross section of the immersed body which offers the least resistance to side motion, and this is very important when broached to, is *elliptical.*

These general features of satisfactory life-boats are interesting, if for no other reason than to show how much they differ from navy boats.

Navy boat-builders, well informed of the prejudices of the service, have generally preferred, in their so-called life and surf boats, to graft a few qualities on the service boat rather than make a radical change. This position seems to be taken in deference to the vanity that places smooth-water speed and trim appearance above seaworthiness.

Fault is not found with the quality of speed, but the method of obtaining it which limits it to smooth water. A good life-boat, but little slower than a whale-boat in the harbor, would easily pass the latter outside. The reason is obvious: speed is improved by rounding off all angles under water. Cambering the keel and raking the stem increase the speed directly. Of all midship sections the semicircle is the fastest; the sharper the bows the better; for the same beam, equal increments of length nearly equally increase the speed.

If these features are developed beyond a certain point, the boat will of necessity have very little stability, being very fine, round-bottomed, and so lively that the weight of one man can dip the gunwale. All the weights must then be carried low; so low that less freeboard can be allowed than is usual in any but light harbor boats. For fear of top-heaviness, the sheer is made less than one-half what it should be, or is a counterfeit, a mere extension of the sternpost and quick upward turn of the gunwale, with very little benefit to buoyancy. On the other hand, the very feature of a low rail, however dangerous at sea, is of advantage to speed in smooth water, for long-bladed oars, with little slip, can then be used. These, lying low,

permit the oarsmen to exert all their strength in *propelling* rather than in *lifting* the boat.

To obtain speed, the lines of flotation of navy boats are made fine, and thus in an instant much buoyancy is lost. The area of the water section being small, a comparatively slight addition of weight, of either cargo or water, largely diminishes the freeboard and renders the boat more liable to ship water than before.

Of course all navy boats must be expected to work in strong currents, and this requirement should be met, in some at least, by *increased length*, to permit finer lines and more oars, rather than by *decreased beam* and consequent loss of power. The size of such a boat, however, would frighten the builder, who would plead for a reduction of beam; and, if beam is reduced, away go depth and sheer, for the boat, standing high out of water, with cambered keel and flaring bow and stern, would be crank.

This then is the trouble with navy boats; they will all stand some increase of freeboard, but if given enough, and in addition the proposed allowance of gunwale sheer, their stability is gone, unless the beam is also increased and the bottom flattened. Such a change, however, would indicate a desertion of traditional lines and loss of speed, especially in currents.

As a rule, while life-boats resemble cutters amidships, their bottoms are flatter, and the midship section carried over a larger body. Heavy life-boats almost always have the keel slightly cambered; if too much so, the boat becomes too lively, pitches, loses speed, and is less steady under sail.

*Speed* is absolutely essential for surf boats; without it all the other good qualities of the most perfect boat would be as useless as Saul's armor was to David. It can be obtained in them, without too great loss of stability, by sharp curves at the bow, shallow bearing, and moderate beam. Weight is the only constant element in the persistence of the force that drives the boat against wind and sea. As the resistance increases, the velocity decreases; weight is, therefore, to a limited extent, an advantage. The bows should not oppose too bluff a surface to the sea, and the end air-cases, if high, should be rounded to offer the least direct resistance to the wind. The crew, too, should be one of power, firmly seated, with sufficient room between the thwarts to permit the independence of action made necessary by the impossibility of precision of stroke.

*Speed under sail.*— Most navy boats will sail well only with a

number of the crew on the weather gunwale and steady bailing by the rest. They *should* sail well even in rough weather without going to this hazardous extreme. One difficulty generally encountered is that the authorities, aware of the crankiness of the boat, cut the sails down until they are "safe" for the most inexperienced coxswain. This, of course, destroys in a great measure the usefulness of the boats under sail, neutralizes available skill and experience, and is a great bar to improvement. It may be truly held by those who, with hand on tiller, feel the boat spring and worm her way onward under all the sail she can stand, now courtesying to a sea, now coquettishly flinging back a veil of spray, that here is opportunity for much careful concentration of mind and sympathy of eye and touch. Cultivate this, and keep full sail power.

Wherever the bearing of the boat can be increased, whether by a wider beam or flatter floor, without much decreasing speed under oars, it should be done; stability will be increased, and greater stability means power to carry more sail.

*Stability* varies nearly as the cube of the beam, and, less accurately, directly as the length. The greater the beam, the better chance a boat has to ride a breaker safely when broached to, as it is not only more buoyant, but the couple to resist capsizing is greater. Stability is therefore more necessary to life-boats than any other quality. It is better obtained by increased beam, especially in sailing vessels, than by lowering the center of gravity. "The beam of some sea fishing boats is as great as $\frac{1}{2.8}$ the length. The greatest beam in birds is $\frac{2}{3}$ the length."

Stability is also helped by ballast. "The boats of the National Life-Saving Institution of Great Britain get it with the aid of an iron keel, flatness, and length of floor, and only moderate beam." With regard to a ship's boat, there should be either a heavy keel, sideboard or centerboard, or considerable ballast. The keel would make it difficult to land on a flat beach, or to turn quickly to meet a breaking sea. The centerboard, if used, must be considered in all operations, but its value in connection with the associated qualities of flat bottom, great beam, and light draft makes it seem the best choice. The sideboard is best in that type in which it is desired to keep the weight of a boat down to the lowest point, to permit a small crew to handle it on the beach. As for ballast, the kind having in this case the least objectionable features is water. Its weight need not be transported, and, if confined securely to a reservoir, fitted to fill or

be pumped out at will, it has many advantages. The ballast tank should have several compartments to prevent the water shifting in case some leaks out.

"Some of the English sailing life-boats are too heavy to be handled by oars alone in bad weather, on account of the large amount of ballast and draft of water required to enable them to stand up under sail. The ballast is generally water filling every unoccupied space up to the water-line. At first this shifting water seems dangerous, but there is so much that the boat cannot be lively, especially as it is cut off (by the air tanks) from access to the ends or sides of the boat. If these boats were more lightly ballasted, they would answer every impulse of the waves, and the water would continually emphasize this by running toward the lowest point. But heavily weighted and propelled by powerful sails, they cut through every sea instead of rising to it. They are frequently completely submerged and the crew hurled about, but they are stable. . . . One was once upset running for the shore; most of the water having been pumped out, she ran her bow into the hollow, which tilted the remainder of the water to that end, when she broached to, turned over, and broke off her masts, remaining keel up, not being self-righting. Had she been properly ballasted, the sea would have broken over her harmlessly. Since that time she has been ballasted with wood."—(Captain Richard Lewis, "Life Boats.")

It is thus seen how the important quality of speed can be assured only by stability, giving certainty to and room for oar action, and ability to carry considerable sail. Further, it has been seen that stability in the lighter designs is obtained by large shallow bearing surface and increased beam, the latter undoubtedly somewhat at the expense of speed, through increased resistance to wind and sea. In the heavier design, the beam is about one-fourth the length, the lost stability being made up by the addition of ballast in the shape of a metal keel, water, or cork. This increases the whole weight—within limits an advantage—and is also a step towards self-righting.

*Buoyancy.*—While ships are divided into numerous compartments provided with double bottoms and the most powerful pumps, the only boats having extra buoyancy are the steam launches, which cannot be lowered or managed at sea in bad weather. Extra buoyancy has been defined as that buoyancy which the boat possesses after the materials composing it are floated. The more that can be obtained of it, after providing space for the crew and passengers, the

better. Not only is the supporting power of the boat increased so much, but its capacity for water is diminished. The manner of its creation and its location are the most difficult problems in designing a life-boat. If too much is placed in the end air tanks, their weight makes the boat unsteady, a large surface is exposed to the wind, the ends of the boat cannot be approached without climbing on them, and finally this buoyancy does not act until the boat is very deep in the water.

If placed on the sides, it becomes almost impossible to capsize the boat, but should this occur, it would be almost as difficult to right her. If placed on the bottom, there is a danger of raising crew and cargo so high as to make the boat unstable. In the Beeching and other life-boats, types of which are in use in many countries, the distribution and amount of this buoyancy is such that while the boat can be capsized only with difficulty by means of a parbuckle, it will quickly right itself when released. This is owing to the turning action of end air tanks, ballast, and iron keel. The false bottom of these boats is placed above the water-line, to afford drainage of water shipped. The space beneath is occupied by ballast and buoyancy tanks, usually filled with cork. A reserve of buoyancy is obtained from a large cork fender running all around the boat just above the load water-line. This adds to the weight, but helps materially when the boat is temporarily swamped and until the water is drained off.

One point must be remembered—with every increase of buoyancy, once having settled its disposition and nature, the weight is increased. Generally speaking, buoyancy is best obtained by detachable air tanks in the upper and cork ballast in the lower parts, thus avoiding the danger of a loss of buoyancy or shifting ballast from a leaky bottom. Some of these tanks, when filling in the space between the under side of the thwarts and the false bottom, are doubly valuable, as they serve to break up and distribute the weight of a sea that may be shipped.

The detachable air tank is of course far heavier than the one built in and forming a part of the skin of the boat. The latter is objectionable—indeed, as bad as none as soon as the boat is stove or becomes leaky; but, until that time, it has all the advantages of the other with the additional one of lightness. Several of the boats, including the first two, most highly spoken of by the committee quoted above, had built-in air cases. They should not, therefore, be rejected without consideration, if it should appear that in no other

way can the weight be kept down to that allowed a ship's boat. Most of the life-boats of ocean steamers have built-in end tanks; a few have, in addition, detachable cylinders about 7 inches in diameter under the thwarts near the sides. Built-in cases should be made very strong and with subdivisions, as a rent in the outside skin from rocks or jagged wreckage, or even a leak permitting the compartment to gradually fill, brings as much pressure to bear on its walls as if it were the outside of the boat itself. "At Winterton, Norfolk, 1829, a life-boat, having great camber of keel, was sent off to a wreck. When filled with people, their weight sunk the boat so low that the pressure of the water caused the false bottom to 'blow up.' Whence we may suppose that the outer bottom was leaky and the inner one flimsy yet air-tight.

*Self-bailing.*—If the boat is not made self-bailing, then precautions to keep the water out are all the more important; these will be discussed under the head of *Freeboard* and *Sheer*.

Self-bailing is commonly effected by closing off all the submerged part of the boat into air or ballast spaces by a false bottom. Above this bottom, ports or scuppers are cut into the side, letting the water run off as fast as it is shipped. Another and more convenient way, as the boat may be kept dry in ordinary rolling and pitching, is to run drainage tubes down through both bottoms between every pair of thwarts. These tubes are furnished with automatic valves opening downward with the weight of water above. They may also be locked or plugged, should it be desirable to increase the ballast when under sail. Some designs employ both methods. With regard to the second method, there are instances noted of the loss of boats through having grounded and choked the drain tubes on shoals and flat beaches.

Self-bailing should be very rapid in order to permit the boat to free herself of one sea and get way on before being struck by another. This can be accomplished only by keeping down the internal capacity of the boat for water, making the freeing ports or valves large, and by raising the floor as high as stability permits, so as to increase the head of flow.

The buoyancy of the submerged portion of the boat must be very great for little draft, in order to hold up boat, crew, and additional weight of water without decreasing too much the head of outflowing water. The required buoyancy can best be obtained without increase of draft by wide beam and long, "flat-round" floor with

little camber. It would also appear that, other things being equal, the light, broad-beamed boat would bail faster than the heavier and finer boat, and admittedly that it need not go to extremes in freeboard and sheer to keep the water out.

Self-bailing has its advantages and disadvantages; with it, stability is diminished; without it, the boat is sooner or later certain to be filled by breaking seas or the surf. The shipping of a single sea may, by raising the center of gravity and cumbering the boat until it is unmanageable, bring about a capsize. The Ranger's navy whale-boats were too heavy and low to be pulled through the surf under oars alone, but they sometimes made the passage of moderate surf, where there was no current, by hauling out with a line. With the bow held always to the surf, a capsize was never feared until successive breakers had tumbled considerable water into the boat. Then, when the water was nearly up to the thwarts, the bow dipped under every swell, and the boat seemed viciously undecided as to the side over which it would roll. Had these boats been self-bailing there would have been no difficulty; though, for that matter, that change would have necessitated an entire change of design.

*Self-righting.*—This quality requires the center of gravity to be kept low, and that of buoyancy high, so that when capsized, the couple formed by gravity and buoyancy will be sufficient to right the boat.

The length of the arm of this couple is increased by concentrating ballast in an iron keel, sometimes weighing over a ton, and raising the end tanks up to and even above a well-sheered gunwale. Opposed to this couple will be two moments, that of a part of the half beam into the buoyancy of the side that is to go under in righting, and that of a part of the half beam into the weight of the side that is to go up. These are reduced to insure self-righting, by narrowing the beam and diminishing the side buoyancy.

The heavy keel neutralizes some of the buoyancy, but it gives back the stability jeopardized by a sacrifice of almost all side buoyancy. The increased weight is certainly of advantage wherever momentum is desirable. Its inertia, however, renders the boat more sluggish with the same power; more liable to be caught in a dangerous position; less likely to benefit by a sudden smooth time in the breakers.

The narrowed beam makes the iron keel a necessity; in fact, makes self-righting a more important quality; but it permits greater speed, and with it, the heavy self-righter holds the palm of power. It is faster at all times in currents.

To equal it, the lighter, shallower boat must put more men on its oars; however, the advantages of quickness and handiness go far towards equalizing its efficiency in a seaway through other means.

The loss of side buoyancy is a great blow to sail power; it can be made up only by such a great addition of ballast as to eliminate at once these boats from consideration as ship's boats.

Raised end air-tanks are of use, not only when the boat is capsized, but when it penetrates a breaker, for then its whole buoyancy is felt in lifting the boat; water ordinarily will not break over the bow or stern into the boat. They are also valuable in keeping the weight of crew and water out of the extremities when the boat is swept by a sea. These high ends of course affect the weatherliness of the boat in a strong wind, but is is claimed that this defect has never, of itself alone, prevented the accomplishment of any undertaking of the British life-boats. "Again, it was foretold that, once thrown out of them, the crew could not regain them, since, being so high out of water, they would be speedily carried to leeward out of their reach. In only one of thirty-five upsets has this been the case. Even when under sail, with sheets fast, they have righted and the crew regained them without loss. The one exception was when a boat was turned end-over-end and carried off by the same wave. In other instances, when broached to, one or more men always stayed by the boat, the others being tumbled out to leeward."—(Capt. Lewis, "Life Boats.")

In spite of these strong statements, it would seem that there is not much hope for the success of *the particular trip or undertaking* if a capsize occurs in rough weather outside. The certain demoralization, however slight, of the crew must leave the boat in a less manageable condition after they have climbed back than it was before the capsize. The advantage would therefore seem to be all in favor of the boat least likely to capsize in the first place, unless the circumstances causing the accident are exceptional and not likely to recur.

It is clear that if the boat is not made self-righting, every precaution taken to prevent capsizing becomes more important.

*Depth, Freeboard, and Sheer.*—The real advantage of stability of form over that of a low center of gravity is, that with a light draft it is possible to carry plenty of freeboard and sheer. By these the water is kept out, the end buoyancy is increased, and space given for clean pulling, or considerable heel when under sail.

The relative advantages of the same freeboard and sheer are much greater in a light boat than they would be in a heavy one.

Waves vary greatly in size and abruptness; a boat will be moved sometimes *on* a large wave, while a smaller one would tumble over the rail. In other words, the greater the inertia of a boat of constant freeboard, the more certain it is that the same wave will come aboard.

With regard to *sheer*, if the rail is straight, there is less surface at the bow for the buoyant action of the coming wave. The rail is low, and before the weight of the forward half of the boat can be transferred and lifted, the crest falls into the boat. The more abrupt the transition from hollow to wave, the more certain this is to occur, making great sheer very valuable in surf boats. For the same waves, the greater the sheer, the more certain it is that the boat will rise to the sea before it tumbles in. If, then, the weights be spaced about the center, the gunwale well sheered, and the bottom slightly cambered, she will lift grandly to almost any sea. The stern must also be sheered and its upper strakes flared, or it will be driven under water.

Sheer is best obtained in combination with rail and end tanks. If the latter are raised above the rail and pointed forward like a whale-back, the same effect is produced as if a much greater rail sheer had been given without these tanks. This method is better for stability and weatherliness under sail; by its adoption, the principle of the conversion of a deep-sea sailing life-boat into a surf boat becomes apparent, the whale-backs being removed in the former case.

Attention is called to the difference in actual benefit derived from the sheers of different boats, all apparently the same on the sheer plan. On the body plan of a lean-bowed boat like all navy whale-boats, the sheer is projected as a small isosceles triangle above the dead flat; in another, as the cutter, the triangle is lower but much broader. The comparative areas of these triangles represent very well the resistance to a topping breaker, and what may be called the *emergency lifting power*—mechanical and hydrostatic when the bows flare—hydrostatic only when they do not flare.

Thus, suppose a heavily laden cutter and whale-boat side by side. The sheer of the latter is somewhat the higher, and, for light surface waves, not sufficiently deep to lift the boat until well under it, might keep out more water. It is so fine and short, however, that it has but little lifting power, and therefore might take aboard a wave that lifts the well-flared, slower rising bow of the cutter. This explains why African surfmen, when employed aboard ship, occasionally prefer cutters for their work in *narrow* surf.

*Fittings.*—It is customary for life-boats to have a norman post in the bow for towing, and one on each quarter for an after-line when lying alongside. A life line with floats is stopped up every 18″ around the boat, except the two bights in the waist, which are narrow and long, to serve as stirrups in getting into the boat from the water. In some cases, lines are stopped along the bilges to give the crew a hold should the boat capsize. These are always a drag, liable to damage when landing on the beach, and are not required on self-righting boats. A much better scheme is to fit the boat with wrought-iron bilge guards, set up an inch and a half from the bottom, to give a grip. Their ends should be bedded in malleable-iron plates, riveted on the bottom in such a manner as to avoid catching lines, kelp, etc. These bars if made 1½″ thick might save the boat from considerable injury when landing on a rocky beach.

All ship's boats intended for use in rough weather should have a *fender.* It should be of cork sewed in canvas or leather, and securely fastened every few inches in a slightly hollowed batten running all around the boat. The fender should vary in size and firmness with the weight of the boat; for the heaviest boats, oak must be substituted for the cork; the latter should ordinarily be 4″x 7″, and lie just above and touching the deep-load water-line amidships; the former may be 2″x 6″ wide in the same location.

The *stem* and *stern posts* should have rollers at the bottom of grooves 4″ deep, and wide enough to pay out a good-sized hawser in warping.

*Boat-hooks* should always have a point, not very sharp, but sufficiently so to prevent slipping and scratching the paint-work. The hook should be very open and rather sharp, so that it can be made to *engage* in the clothes of people in the water, or by a blow be sent into an object that otherwise presents no holding surface. If bowmen are accustomed to splinter up the gangway and scratch the ship's sides, they should be watched, and even made to use the handle of the boat-hook instead of the point. Their carelessness should not be countenanced by destroying the efficiency of so important an implement. The ball at the point of service boat-hooks frequently toggles itself in gratings or guard-rails. Boat officers have sometimes been obliged to shove off quickly from a gangway, leaving, to their chagrin, one or two boat-hooks hanging to the ship's side.

The oars should be light, reasonably stiff, and not too long; balanced on the rail, which tumbles home slightly amidships, for

greater strength. Oars, like masts, should be strong enough for all ordinary strains; beyond that, strength is injurious, as it might occasion the capsize of the boat. The oarlocks should be swivel, or tholepin and grommet, high enough above water and thwarts to permit a high rolling stroke. In most life-boats and New Bedford whale-boats the thwarts are eight inches below the rail. Dovetailed swivel oarlocks are nearly as bad as inserted rowlocks in case the oar is jammed. They should never be used in the surf or at sea.

There is much diversity of opinion about elastic oars. Doubtless this quality causes the oar to act as an accumulator of force, which it imparts to the water uniformly, producing an even pressure throughout the stroke. It will return all the force put on it when the stroke is not broken by the motion of the boat or sinking away of the water. The bending should not, however, be so great that power is lost by the oar kicking in the air at the end of the stroke. A limited amount of elasticity eases both oar and man, but for quick work, oars should be rather stiff. The blades should be nearly six inches wide; otherwise, with boats moved slowly against a head sea, there will be much loss from slip. It may also be noted that in pulling against strong currents long oars should be used; the speed of the blade being greater, the stroke need not be so fast to keep the strain on the oar. There is a narrow limit to these considerations, however, depending on the ability of the crew to handle heavy oars, and the roughness of the sea. The readiness of handling, the smaller exposure to baffling wave points, and the decrease of work in swinging them, makes the short oar preferable whenever broken water is encountered. There should be two steering oars in the life-boat, one pointed forward, the other aft, so as to be ready to pull either way without shifting either oar or coxswain. It is apparent that with a heavy turning boat, the best result will be obtained from the coxswain's strength when the oar is dipped closer than in the case of an easy turning boat. The loom of the steering oar should be oval, with the larger axis at right angles to the blade, so that it will naturally lie, in a wide crutch, in the position for immediate action—an important quality at times. There should be a steering crutch socket in each bow and quarter, for the convenience of a single steersman coming up on either side of the ship; also a crutch in both stem and stern posts, for use when two men are at the oar in heavy work.

Trailing lines should have a close-worked grommet or metal ring

sliding on the loom between neat stops so spaced as to permit the oars to be trailed, boated, and handled without repeated adjustment.

The rudder, for sailing and ordinary work, should be of a design easily fitted when in motion. As it is heavy and there is space for but one man to work, this can never be accomplished if the nice adjustment of several points at the same time is necessary. It is better to have a single very stout pintle rove through the several gudgeons and then hasped in at top. The rudder is certain to be exposed to much rough usage in landing, crossing shoals, etc. White yoke ropes, touched up with a rosette or two, will not soil the gloves and will look very pretty on dress occasions. For rougher work, however, a curved metal tiller is preferable. It should have a long bearing in a metal socket firmly stayed by straps to the rudder.

The *stretchers* should be at least six inches wide and canted to give a solid bearing to the sole of the foot. Narrow stretchers, whether they cramp the foot or not after long pulling, are certain to get men in the habit of pulling from their hips rather than from the point of support. Their position depends on that of the thwart with regard to the gunwale, the freeboard, length of oars, and size of oarsman. The best results, therefore, will only be obtained by having a separate stretcher for each oarsman. Once adjusted, it should be securely lashed or buttoned down.

*Thwarts.*—For communication with the shore through moderately heavy surf and with vessels at sea, for picking up a man overboard, and for ordinary harbor work when it is not desirable to employ a steam launch, a light single-banked surf-boat may be employed. The thwarts in most single-banked navy boats are 32″ from center to center. In most *double-banked* life-boats this distance is 36″; the thwarts being so spaced that, with the crew alone in the boat, the weight and stowage room are nearly equally distributed about the center of buoyancy. The center of gravity should be very slightly in rear of the center of length, to facilitate quick rise to a sea. All navy boats should have the thwarts arranged in this manner at sea; in port it would be very easy to shift them into any position required by the duty, the rail being furnished with additional sockets for oarlocks.

So long as the sternsheets form the only stowage space of navy boats, it will be impossible to adjust their lines to all circumstances of cargo and weather. Many a young boat officer in coming along-

side light has been surprised and mortified to find that his rudder is all in the air, and, unless his efforts are ably seconded by a sympathetic boat's crew, may carry away the gangway. This need happen to him but once, but the same boat used at sea to communicate with other vessels, to save life, or to pass the surf, is always jeopardized and apt to broach to, through being down at the head.

The collection of gratings and bottom boards that lumber up navy boats should never be left in them at sea. They conceal and form receptacles for the dirt. They float about when water is shipped, and bruise and incommode the crew; or if lashed down, they must be frequently raised in order to bail. Navy boats have so little buoyancy that a great difference is felt in their management, even before the water is up to the sternsheet gratings. It is no exaggeration to say that there are boats in the service containing a weight of unnecessary rubbish, which, if turned into metallic end and bottom tanks, would make them non-sinkable and perhaps self-bailing.

The weight of footlings and risers, floor pieces and gratings, in bow and stern would be no more than that of a false bottom of wood or sheet copper, which would really make a much stronger boat. The weight of the keel and unnecessary dead wood at forefoot and run could be worked into a centerboard well large enough to serve both as a ballast tank and subdivision of the bottom tank. With the weight of the stanchions, boat box, and boat stove case, at least three water-tight lockers may be built under the midship thwarts, thus increasing both buoyancy and stowage space without changing the weight. Finally, if the boat, instead of being carvel-built, had been metallic, or, better still, diagonal-built, sufficient weight would have been saved to increase the freeboard amidships 6″, the sheer 12″, fit a proper ballast tank with automatic valves, fit draining valves, and increase the subdivision of the buoyancy tanks.

These statements are acknowledged to be founded on very rough calculations; nevertheless it must be apparent that if proper precautions are taken to keep down the weight, a good self-bailing life-boat need be but very little, if any, heavier than the average navy boat of the same size.

*Material and Construction.*—The first boats of the Royal Life-Saving Institution were clinker-built of oak. The new ones are diagonal built of mahogany, which gives great strength and elasticity. Tredgold, comparing various woods with cast-iron as unity, found for

Oak, good English, sp. gr., .83, strength, 0.25; extensibility, 2.8; stiffness, .093.

Mahogany, Honduras, sp. gr., .56; strength, 0.24; extensibility, 2.9; stiffness, .487.

Thus it would appear that a boat built of mahogany, weighing one-third less than a similar one of oak, and possessing practically the same strength and extensibility of parts, would be actually much stronger, through the mahogany being five times stiffer than the oak. In addition there would be less working, etc., so detrimental to the tightness of built-in air and water tanks. Haswell makes the sp. gr. of *cedar*, .561; of *white pine*, .554; of mahogany, .56.

A few boat-builders will declare the carvel-built boat to be the strongest, possibly because they put in great frames that will stand rough usage. But then the whole strength of the boat depends upon these frames; if one is cracked, as frequently happens in landing in the surf, it is a serious matter, at once throwing additional strain on those adjacent.

In the clinker-built boat this is also true, but to a much less extent; the planks depend on the frames, such as they are, for their shape, but on each other for support.

The diagonal-built boat, however, cannot be injured except locally; it is the strongest, most elastic, and lightest. Its chief objection appears to be its cost.

With regard to metallic boats. It is claimed for the Francis metallic corrugated boats that they are stronger and lighter than any others; that they cannot become "nail-sick," worm-eaten, or water-soaked; they are unaffected by heat of sun or fire; there is no shrinkage to open seams, and they are not liable to be broken in landing; they are always tight and not liable to damage by concussion or blast of cannon in the vicinity; there is no danger to the crew from flying splinters, nuts, or rivets in action. Their first cost is greater than that of wooden boats, but afterward it costs nothing to keep them in order.

There is undoubtedly an aversion in the service to metallic boats. How much the talent on hand in our navy yards for building wooden boats has to do with this can only be surmised.

If a metallic boat is worn out or rusted through, it will go to pieces when least expected, like the famous one-horse shay; some day a member of the crew will step down off the rail through both bottoms. The experience of many officers in the service with worn-out iron

steam launches would furnish an interesting corroboration. If this is the only objection, however, it is not sufficient. Pulling boats are out of the water four-fifths of the time and their condition can be easily examined. Their fitness for a cruise must be determined at the navy yard before being assigned to the ship, just as in the case of wooden boats. Like all other parts of the ship's equipment, they have a life, the length of which depends almost entirely upon the way in which they are treated; and their failure need not occur in service unless they have been employed long after their condition indicates the advisability of retirement.

*Sails.*—Almost all writers on life-boats and deep-sea fishing boats praise the split lug sail above all others. It is not so pretty as the "sliding gunter," but it is less complicated, and certain to set better, especially if the latter has been lowered by cutting off the foot to make it "safe."

The lower lug sail, when reefed down, may become becalmed in the trough of the sea, but it is more stable and easier to handle. Of course a boat may be endangered by carrying too little sail to be easily managed.

In any weather, such extreme caution is but one form of bad seamanship. A coxswain may sometimes be censured for carrying too much sail in rough weather when the very safety of the boat requires her to have way enough to cross the hollows; if necessary, to luff promptly, to fill away as quickly, and to keep up headway with wind abeam when the sheets have been eased freely or let go altogether. The sail that a good coxswain would carry in a steady strong breeze *might* be censurable if carried in a lighter but squally or shifting wind. In fact, a precaution may not be needed sometimes, which, with less vigilance, would fail to save the boat.

Navy boats, to be properly handled under sail, require the concerted action of several people. Neither good results nor mishaps can be ascribed wholly to the skill or ignorance of one man, be he coxswain or boat officer. It is hardly a fair thing to select the time to brail up foresail and jib, and then blame the coxswain for failing to reach the gangway with rudder and mainsail.

Boat drill under sail in a light sea would be excellent training in nerve and seamanship. So long as the present type of navy boats are employed, the crew will be obliged to get up on the weather rail and bail continually. Every man in the boat should wear a life-belt. Many will object, through a foolish pride in their strength, but as

soon as the novelty of the drill wears off, they will take a practical common-sense view of the matter and put the belts on without a murmur. It is desirable to have a steam launch cruising near at hand, until the crew has obtained some skill and confidence, and a knowledge of what the boat will stand.

Whatever gear is put in a boat intended to risk a capsize, to accomplish something where the most sanguine can hardly hope for success, should not only be really necessary, but it should be of the simplest description. Tackles, with their "dips" and "thoroughfoots," are an abomination where it is possible to accomplish as much by "swinging off." Wire shrouds and stays, if used at all, should have a rope pendant worked in at a point accessible when the boat is capsized.

In case of a capsize, the boat should be at once cleared of its masts and sails, cutting freely to hasten matters if the water is at all cold; then, riding by the wreckage, right the boat, and rock it on the wave crests until considerable water has been thrown out. After this, with one or two men bailing, she will soon become habitable. Everything must be done with the utmost quickness, for the buffeting of the waves, and especially the chill of the water, make the men lose strength rapidly. Once they feel themselves at all weakened, few will have nerve enough to do more than to hold on.

Crews should be taught to regard a capsize as a not improbable or even rare occurrence; the resulting condition of things should be pointed out, and the men encouraged to think of the most expeditious way of clearing and righting the boat. While not making the crew in any way reckless, or permitting any laxity of discipline, it may teach it to look on a capsize, not with horror and despair, but as a difficulty, great indeed, but still one that can be surmounted.

*Weight.*—It will have been seen that in the discussion of the various contradictory qualities of life-boats, the *pros* and *cons* crystallize most thickly on two types as different in design as the American centerboard schooner and the English cutter.

Where weight need not be limited, or the boat landed on a shoal beach, all arguments must narrow down to a decided approval of the heavy life-boat. Its weight and narrow beam form the powerful combination of great momentum and small resistance, enabling it to penetrate and struggle through a sea that would hurl back a lighter boat. The completeness and value of its automatic functions are proven by the fact that a much smaller percentage of people have

been lost from capsized self-righters than from non-righting boats.* Yet these boats appear to the seaman very artificial—their power to *resist* capsizing is kept down to permit them to right when capsized; for the same reason stability is impaired by great sheer and high end tanks. All this is adjusted and ameliorated by a massive iron keel and cork or water ballast. These boats are frequently swept by seas, and yet the crews lash themselves to their thwarts with full confidence that the boat will shake herself free. And if it fails—if it is driven back and capsized—still with its wonderful powers it takes better care of its fettered crew than they could themselves if free.

There must be strong reasons for selecting a less perfect boat when the importance of the stake is considered. The main reason is the necessity of limiting the boat's weight.

Aboard ship the greatest difficulty in using the boats in rough weather, or when wrecked, will be in getting away from the ship. This difficulty increases many-fold with the boat's weight, both on account of its requiring more men to handle it, and because the shock of its weight on water or ship is more destructive. Aboard ship heavy boats are a nuisance, however buoyant and valuable when once clear of her; every precaution must be taken to secure them rigidly, and it is a rare thing to find a boat so secured that the lashings may be eased at sea without danger. Heavy boats require a large crew to act as one man; the weight on the davits year in and out is not only a source of deterioration, but increases the ship's top weight and renders her more vulnerable to the onslaughts of wind and sea. To hoist them every member of the ship's company is frequently called to man the boat's falls, and so impossible is it to handle this scattered strength with the required nicety that often the effort dare not be made at all.

Occasion may arise when it is necessary to land in terrible surf, passable by none but the best and largest boats, but ordinarily the choice of the boat will be determined by the ability of the crew to return unaided. In addition, few ships will be able to preserve intact

*"35 self-righters have upset, on board which were 401 men. Only 25 men were lost; of other life-boats, 8 capsized with 140 men, 87 of whom were drowned."—(Captain Lewis, "The Life Boat.")

It is no more than an indication that the conditions are different on the Atlantic Coast of the United States that better results are obtained with the light non-righting boat. See abstract from report of General Superintendent Kimball, U. S. Life-Saving Service, page 308.

the trained crew required for a large life-boat. It is customary in very heavy weather to *double bank each oar*, thus making, with a hand at the bow heaving line, another at the quarter, and two men on the steering oar, a crew of twenty-four men for a ten-oared life-boat. What a magnificent barge such a boat would make!

The advantages and disadvantages of the less perfect though more natural type, which has outlined itself in contrast to the forced design of the heavy boat, may now be considered.

The stability necessary for freeboard, sheer, and clean pulling back stroke is obtained by a small increase of beam and a flat floor, no metal keel being employed. By this change, self-righting is given up (with a saving of one-third the weight), momentum is lost, and speed slightly diminished against head-seas or currents. On the other hand, the lightness and shallow draft makes the boat lively, and it evades or mounts over seas into which the heavier boat would burrow. Recognizing the fact that the proportions of the latter are fixed within certain narrow limits by the variety and contradictory nature of its requirements, while there is great range allowed in the former, it would seem possible to design a faster boat of the lighter pattern, better for every purpose except when the sea is extremely high and rough. To investigate: height of freeboard and sheer need not be so great, as there is less chance of the water coming in or a sea swamping the lighter boat. Also, as the end tanks are not built especially for self-righting, they may be made much smaller and lower. In this way stability is improved, and the internal capacity for water being diminished, a much smaller demand will be made on it when the boat is swept by a sea, especially as the side-fenders increase the actual submerged beam as soon as water is shipped. It is thus apparent that the stability of the light, unballasted, flat-bottomed boat *may* be just as great as that of the heavy-keel boat of the same beam, under like circumstances. It is only because the non-righting boat *must not capsize* that the beam is at all increased.

Again, with a large, shallow bearing surface, small internal capacity, and great buoyancy, the light boat will keep herself dry, while the heavy boat, with finer lines, will ship much more water, and sinking deeper, drain sluggishly. A condition of the waves may therefore be imagined in which the light boat is always light, dry, and fast, while the heavy boat, ramming every sea and burdened by the constant shipping of water, labors along in the rear.

Let the force of wind and sea increase. The heavy boat crawls

on, more slowly but as persistently as ever, for the force of its crew, stored in its weight, is sending it ahead despite the impact of the waves. The light boat, however, is plainly beginning to be distressed; the crew spends more and more power in *rowing up the moving seas*, only to be checked by the driving gale when balanced on their crests.

It has been shown that with almost every desirable quality of a good sea life-boat there are corresponding disadvantages. Experience has taught surfmen what qualities of boats are most important in their locality, and how much other features may be sacrificed to the advantage of these. In the numberless ways in which disaster or need may come to those at sea, still other qualities take precedence. It is more important that a ship's company should be able to get away from a sinking ship and keep afloat, than it is necessary that they should have at their command the ultimate excellence in boats for landing. Yet one and the other may be identical in case of a wreck on the coast, and such is our respect for even a moderate surf that we cannot permit the sacrifice of any qualities essential there. It is certain that if a boat can live in the surf it can in the sea outside, and so the question narrows down to limiting the weight of a surf boat to that which can be handled and carried aboard ship.

It is confessed that the mere presentation of a design, believed to be the type of a man-of-war life-boat, but states the problem; the solution is in the hands of the service. If such a boat is wanted, mature deliberation must remodel all that criticism demolishes.

*Detaching Apparatus.*—It must be said that the service exhibits but languid interest in the many designs of detaching apparatus, and the reason is simply that no such device can in itself ensure the safe departure of the boat. There are numbers of bad ones, liable to all sorts of eccentricities, and a few really good ones, with all their parts in sight.

All, however, halt at a half-way point; they cause the boat to part company with the falls, but not with the rolling, wave-beaten ship. A few designs recognize this difficulty, and attempt to overcome it with longer, or extensible, davit heads; one device has bearing-off levers hinged at the water's edge. It is surprising that so much attention has been paid to *detaching apparatus* and so little to *means for hoisting*. Generally, the anxious moment with heavy boats comes when the falls are first hooked. With care and plenty of tackle, or better still, as it is unlikely to foul or twist, a long pendant

and whip, the falls may be permitted to unreeve; or hooking on may be easily accomplished at an oar's length from the ship's side. The seas are indifferent to swiftering lines; they batter the boat against the side, lift it, and, despite quick work on the falls, let it drop. A misgiving may sometimes cross the mind of the supervising officer as to whether it would not be considered better seamanship by some to let the boat go adrift or swamp astern than lose it in hoisting.

In no boat is simultaneous detaching more necessary, in any weather, than in the heavy ones carrying large crews. Yet it is an exceedingly rare thing to find one of these boats fitted with detaching apparatus. It seems to be decided on shore that these boats shall not be lowered except in smooth water, though they are the only ones that can be expected to make headway against a wind and sea.

On modern ships, the yards, less used for sail now, are still used as derricks in lifting boom-boats and other heavy weights. The mainyard in particular, smoke-begrimed, collecting soot during a cruise to distribute it at leisure until the awful cleaning day comes, must still be straddled every day to rig a "water-whip" or "yard and stay." Many boats now-a-days must still be hoisted out by the ponderous "triatic," the rigging of which requires generally a comprehensive derangement of crew and tackle. Matters are improved on some ships by the lighter boats being stowed amidships, and the heavy ones in cradles immediately under their swinging davits. Still it requires considerable time and method to get all the boats out. Some of them, though the most important in case of shipwreck, are so stowed as to be necessarily the last lifted.

With regard to davits, there appears to have been no advance over those on the first ships built, other than the graceful curves and smaller thickness permitted by the substitution of iron for wood. They still project in an ungainly manner, offering greater resistance to wind and sea than is at all necessary, while their rigidity and permanence compels a general dismantling before coming alongside a dock or other steamer. In fact, people have become so accustomed to this type that many consider them as natural as trees, or, for that matter, think that by their removal men-of-war would be robbed of a most striking characteristic. Yet they are an unnecessary and unsightly encumbrance. Most of the difficulties with boats in rough weather are due to their inefficiency. They are in the way of the battery and a clear all-around view; they increase the top-hamper

and gear; invite the destruction of the boats by every heavy sea, and may make ramming seem even more desperate and suicidal than it is.

On several of the new ships a number of the boats are stowed in two rows athwartships, lying in cradles on a superstructure just abaft the forward bridge. On some armor-clad cruising battle-ships they are placed well back from the rail, on a superstructure.* These are excellent places for them, as they are out of the way, easily secured, and permit vessels to go alongside of each other, or the wharf, with nothing to look out for but the guns. The old davits are still retained, however, only, as in the case of monitors, they present new complications and are less efficient than ever.

Undoubtedly the simplest method of all for hoisting in and out these boats or any other heavy weights, and of avoiding the use of the mainyard to get aboard every barrel of provisions, is by light cranes on both sides of the ship, worked by hand and steam.

These cranes should be capable of lifting the steam launch from the water to the ship's deck, of transferring boats from one side of the ship to the other, and, at least one on each side, of swinging a life-boat and crew at least 12′ clear of the ship's side. Each boat should be fitted with its own slings and balanced with the crews on their thwarts. In the case of heavy boats, a two-legged sling and supporting band around the midship section may be used. Davits should not be used at all unless they swing inboard and land the boats, a condition that will usually interfere with the needs of the battery. The crane should be capable of high speed for rough weather work; in addition, to expedite matters, one of the parts of the hoisting whip may be run in by hand.

It may be said that a seaman should not thus be permitted to lose the special skill required in purchasing heavy weights. The answer is that there is no danger of seamanship falling into disuse through lack of difficulties requiring its special knowledge. The navy has every day more and more the need of *thinking* seamen. There are

*The boats of the Maine are stowed in this manner, there being a light swinging crane on each side of the superstructure, by which they are handled. As the arms of these cranes are just long enough to plumb the boats when lying alongside, they will be no better than the old-time davits for hoisting or lowering in rough weather. They are, however, light, neat, out of the way, and useful for many other purposes. It would undoubtedly be an advantage to have the boats of all the cruisers stowed in this manner.

too many actual problems to solve in the new state of affairs to permit the continuance of any drill or work which is no longer necessary.

In justice to the writer, it must be stated that his conclusions with regard to the best type of ship's life-boat were reached and the preceding pages written before he had learned the character of the light self-bailing surf-boats recently tried in the U. S. Life Saving Service. The latest design, the Beebe-McLellan Self-Bailing Surf-Boat, has been in use but two years. It is believed by General Superintendent Kimball to be adapted to ship's use. Through his kindness it is possible to give the plans and specifications in the appendix. It will be noticed that the beam is 28 per cent of the length, the depth, 29 per cent of the beam, the sheer, 1″ to each 1′ of length, and the draft, about one-half the freeboard. The end air tanks do not rise above the thwart line. Some have been fitted with centerboards and a sail. Although only 25′ long, their nominal load is 26 people, including crew. Of course, for ship's use larger boats would be built.

The capacity of a ship's life-boat of this description, not necessarily self-bailing, may be found by the "rules made by the [British] Board of Trade, under the 'Merchant Shipping (Life Saving Appliances) Act, 1888,' to come into force on the 31st March, 1890." Ten cubic feet of boat capacity are allowed for each adult person in a life-boat fitted with air tanks; in others without air tanks, through having more space, eight. The capacity is calculated from this formula: Length × breadth × depth × .6.*

The capacity of a Beebe-McLellan boat 30′ long would therefore be $30 \times 8.4 \times 2.516 \times .6 \div 10 = 38$. If such a boat was provided with a centerboard, and a tank on each side that might be pumped full of water for ballast when under sail, it would make a fine 12-oared ship's life-boat.

*_Life Rafts._—"For every person so carried, there shall be at least three cubic feet of strong and serviceable inclosed air-tight compartments, such that water cannot find its way into them."

_Buoyant Apparatus._—"Approved buoyant apparatus shall be deemed sufficient for a number of persons, to be ascertained by dividing the number of pounds of iron which it is capable of supporting in fresh water by 32. Such buoyant apparatus shall not be required to be inflated before use . . . ."

_Life-belts._—"An improved life-belt shall mean a belt which does not require to be inflated before use, and which is capable at least of floating in the water for 24 hours with 10 pounds of iron suspended from it."

In order to give an idea of the comparative value of the U. S. Life Saving Surf-Boat and the heavier types of English life-boats, the following extracts are made from the statement of General Superintendent Kimball, of the "Organization and methods of the United States Life Saving Service. Read to the Committee on Life-Saving Systems and Devices, International Marine Conference, November 22, 1889."

"The type of boat in most general use in our service, although properly entitled to be called a life-boat, is distinctively known as the surf-boat, and this term will be applied to it in the remarks which follow. . . . Three varieties, respectively designated the Beebe, the Higgins & Gifford, and the Beebe-McLellan surf-boat, from the names of the persons who devised the modifications which characterize them, are the only ones furnished to the stations in recent years. They are all constructed of white cedar, with white-oak frames, and their dimensions are from 25 to 27 feet in length, 6½ to 7 feet beam, 2 feet 3 inches to 2 feet 6 inches depth amidships, and 1 foot 7 inches to 2 feet 1 inch sheer of gunwale. Their bottoms are flat, with little or no keel, and have a camber of an inch and a half or two inches in 8 feet each side of the midship section. They draw 6 or 7 inches of water, light, and weigh from 700 to 1000 pounds. They are propelled with 6 oars without sails, and are expected to carry, besides their crews, from 10 to 12 persons, although as many as 15 have been landed at a time in a bad sea. Their cost ranges from $210 to $275. There is no great difference between the Beebe and the Higgins & Gifford boat, except that the former has more sheer and is clinker-built, while the latter is of carvel construction. The Beebe-McLellan boat is the Beebe boat with the self-bailing quality incorporated. This feature has been added within the past two years, and but few of them have yet been put in service. . . . Even at those stations where the most approved self-righting and self-bailing boats are furnished, the surf-boats are generally preferred by the life-saving crews for short distances and when the number of imperilled people is not large. . . . As respects safety they will compare favorably with any other boats. In 18 years they have been launched 6730 times on actual service, and landed 6735 people from wrecked vessels. They have been capsized but 14 times. Six of these instances were attended with loss of life, of whom 27 belonged to the service and 14 were shipwrecked people. . . . I learn from the annual reports of the Institution [Royal National Life-Boat Institution of Great Britain] that during

the same period of 18 years, her boats (self-righting and self-bailing) capsized 21 times, attended by loss of life, 68 of the lost being life-boatmen and 7 shipwrecked people. I find by the official report . . . in December, 1866, to Board of Trade (British) . . . that during the previous 32 years, the self-righting boats of the Institution had been launched in actual service 5000 times, . . . 'the 76 life-boatmen lost represented about 1 in 850 of the men afloat in life-boats on service, and the capsizes, 1 out of each 120 launches on service.' . . . In the case of our capsized surf-boats, the 27 men lost represented 1 in 1744 of the men afloat in surf-boats on service, and the capsizes, 1 out of each 480 launches on service. . . . We find, then, 1 capsize of the surf-boat to every 464 persons saved; a difference in its favor of 172. The self-righting boat lost 1 life to every 136 saved; the surf-boat, 1 to every 158 saved; a difference of 22 in its favor. Of the life-boatmen afloat, 1 to 850 were lost by the self-righting boat, 1 to 1109 by the surf-boat; a difference of 259 in favor of the latter. In the life-boat, one man of the crew is lost to every 157 lives saved; in the surf-boat, 1 for every 240 saved; a difference in favor of the surf-boat of 83. . . . Since 1876 there have been put into the United States service 37 self-righting and self-bailing life-boats of the model of a boat received from the Royal National Life-Boat Institution. . . . They are 29 feet 3 inches in length, 7 feet 7 inches beam, 3 feet 1½ inches deep amidships, 1 foot 10 inches sheer of gunwale, straight-bottomed, pull eight oars, and weigh about 4000 pounds each . . . a heavy iron keel . . . securing the self-righting quality. . . . The boats have capsized once in each 118 trips, and once in rescuing every 146 persons, and one life has been lost from the boats to every 117 saved. There are two other varieties of self-righting and self-bailing boats in the service—the Richardson and the Dobbins. They are modifications of the life-boat just described, though considerably lighter. . . .

"Among the boats at present employed in life-saving institutions, I know of none that can be justly denominated the best life-boat. The type that is best for one locality may be ill adapted or entirely unfitted for another, and a boat that would be serviceable at one time might be worse than useless at another in the same locality. . . . The keeper steers with a long steering oar, and with the aid of his trained surfmen, intent upon his every look and command, manœuvres his buoyant craft through the surf with masterly skill. He is usually able to avoid a direct encounter with the heaviest

breakers, but if he is obliged to receive their onset, meets them directly 'head-on.' His practiced hand immediately perceives any excess of weight thrown against either bow, and instantly counteracts its force with his oar as instinctively and unerringly as the skilled musician presses the proper key of his instrument. He thus keeps his boat from broaching-to and avoids a threatened capsize. The self-righting boat is more unwieldy and not so quickly responsive to the coxswain's tactics, and is therefore not so well adapted to our general work. . . . I have given these results in comparison . . . to show that the United States has provided quite as effective means for dealing with the conditions presented to it as the most eminent organization of other countries has for its conditions. . . . May it not be a question whether these properties (self bailing and self-righting) and the means of propulsion by sails cannot be advantageously incorporated into the surf-boat without materially increasing its weight and draft, and whether such a boat would not be found to be better adapted to perform the general services of life-boats than those which sit deeply in the water, and which on that account, and because of their great weight, are less agile in action and more difficult to transport and launch? And why, since it has been found that the self-bailing principle can be applied to a model thoroughly convenient to be carried on shipboard, may not these vessels even now be supplied with self-bailing boats, in which the liability to capsize is greatly diminished by reason of their ability to immediately free themselves of any water they may ship?"

It is believed that the best boat for ordinary ship's use would be a light whale-boat built on the lines of the Beebe-McLellan boat. If 29′ long, 8′ beam; depth, 2′ 4″; sheer, 2′ 5″; draft, 10″; freeboard, 18″; fitted with side air tanks and false bottom; draining through centerboard well, towards which bottom slopes, and carrying two lug sails, it will be a vast improvement on the 29′ whale-boat now furnished the new cruisers, especially if a portion of the bottom permits water to be let in as ballast. It may be said that the 32′ launches are heavy enough now. It is certain, however, that a boat of that size once shipping a sea would remain unmanageable for so long a time before being bailed out as to run the chance of being repeatedly swept and finally swamped. By adopting a less heavy construction in these boats, it may be possible to put in a false bottom for draining without increasing the weight more than five per cent. The 24′ cutters should be either metallic or increased to 26′, with 6′

9″ beam, flatter bottom, air tanks under bow platform and thwart, around stern sheets, and in half-round tanks under the thwarts out against the side. A ballast tank, if needed, may extend from the centerboard well out to the sides.

The 28′ cutters could be better replaced by very light non-sinkable surf-boats. If these are made as light as the combined strength of the diagonal system and mahogany wood will permit, they may be made self-bailing. In all of these boats, air tanks for stowage of boat still, provisions, and repair articles should be built between the bottom and thwarts; limber holes 4″x 18″ may be left for passage of water.

It will be noticed that the Beebe-McLellan boat is essentially a compromise; none of the air tanks are detachable; it is clinker-built; there are no air tanks under the thwarts or above the seats in the ends. In consequence, a sea shipped over the bow will run under the thwarts and out over the stern; passengers may be taken in end on. The draining valves are large but simple rubber flaps; they are placed farther from the center than usual in order to act when the boat is rolling.

## Part II.

*Duties.*—The requirements of the coast life-boat have been investigated with the aid of such authorities as are within reach. That phase of the problem is now encountered which can only be solved by the naval officer.

The question is, Do the special duties of navy boats prohibit a radical change if a gain be made in seaworthiness and the weight increased not more than 5 per cent. or 10 per cent.?

Much light will be thrown on the problem by a comparison of the crews and their duties in the past with the changed conditions of the present.

In the modern man-of-war we are at once struck by the simplicity or even absence of sails and spars, and the much greater complication of battery and adjuncts, than was the case in the ships of 1860. In some an attempt is made to retain the great sail power of thirty years ago, but generally the prime object of the ship, that of fighting under steam, has come to the front. The old-time battery was large but very simple, so simple, in fact, that detailed instructions for every move of hand in its service, ordinary and extraordinary, could be gradually mastered by the most ignorant man in a series of easy

drills. The handling of sails and spars, however, was a different thing; it was the profession of a lifetime, and many a man efficient enough in gun drill never could become a *real* seaman, no matter what he might be rated. With all the infinite variations of sea, wind, sails, and course, peculiarities of the ship, etc., the progress of a watch was a panoramic problem which the true seaman was constantly solving. No matter how terse the orders of the watch officer, or well drilled the crew, the method of execution was as varied as the circumstances that compelled the change. In fact, a change of any sort *compelled every man involved to think.* This is the grand secret of the adaptability of the sailor. It is not a difficult thing to follow a rope with the eye until the cause of its jamming is determined.

When, however, this is done instinctively, or mentally, as at night; the reflective principle, so weakly illustrated, pervading the whole life, dealing with the irresistible sea, the invisible wind, gaining, in spite of them, an indirect advance where the direct is impossible; when men every hour of the day and night trust unflinchingly to the skill of their own hands and brains in matters where failure would be comprehensive ruin,—then a swiftly decisive but philosophical character is formed, and men are made proud of their profession and ships, when the praise might well be given to themselves. Amid the changing circumstances of every evolution certain necessities rose paramount, and these were recognized and provided for in station-bills of an exceedingly accurate and detailed description. It is the boast even now of many an executive officer that when his crew first came aboard each man was prepared to stow his hammock in the proper netting, take his proper place at his gun, eat at his own mess table, and at sundown evolution tail on to his own boat-fall or yard-rope.

In time of storm and emergency no *seaman* ever failed to find his proper billet, though it was not always the one assigned him on the station bill. Despite the careful forethought and subdivision of labor, in time of trouble the artificiality of the system at once became apparent.

Seamanship was a work of precision only in the final execution; in the preparation, individual intelligence and adaptability had full sway. In the quarter-bill, a large number of men were assigned to each one of twelve or fifteen billets requiring performance of simple and exact duties. On deck, the man made his own billet,—within limits. If he was absent, his work was divided; it did not fail to be done. Hence, in spite of the apparent rigidity of the station-bill, its

details were frequently ignored. From this it follows that there were a large number of men whose duties were nominal, or easily transferred and distributed. Thus, having the use of numbers of men without interfering with the routine, a pardonable pride in good appearance originated the present style of navy boat with its large crew and small carrying capacity.

In the future, however, the larger proportion of skilled and rated men, and the very great variety of duties required of men of ordinary capacity, will make it necessary to assign at once all intended substitutes in the battery to regular duty. The neglect of certain of these new duties would have serious consequences, though not at once apparent, as would be the case in sail and spar evolutions. It is all the more necessary that there should always be some one at hand to perform them ; thus leaving but few men whose absence in boats would not be felt. At present, the difficulty is met by detailing a single boat's crew, usually that of the steam launch, to do all regular boat work while in port, in the meantime excusing them from all other duty. It is clear in consequence that little boat duty, other than that of smooth-water drills, may fall to a seaman not in the running boat's crew.

As for the operations of "cutting out" and "landing where likely to be opposed." It is not probable that a battle-ship will be permitted to risk her crew, trained with patience and care, in a landing where likely to be opposed by modern firearms. It is difficult to call to mind any place in the world where a commander would dare to risk his pulling boats in hostile rivers or harbors. On the open coast, the ship's secondary battery can drive the enemy back so that a peaceful landing can be effected, were the boats not certain to be swamped in their attempt to carry a load of passengers through the surf. In fact, operations by pulling boats in closed harbors, unsupported by the ship's powerful battery, are not to be thought of, unless boat guns are employed in sufficient force to overcome all resistance at artillery range before the attempt to land is made.

The terrible rapidity of fire, the range, and consequent power of concentration of modern firearms have compelled many changes in the attack on shore. The loss is minimized by scattering the men, at the same time permitting the largest possible number to keep up the return fire. Many tacticians claim that so long as the ammunition of the attacked holds out and they are not shattered by artillery fire, their front is invulnerable. Front attacks are generally disastrous, and rarely

employed except to force the enemy to adopt or keep a certain line of battle.

In boat attacks, catastrophes must occur. Only a very small part of the force can be put in action, while the whole of it forms a target for concentrated fire. It is true that formerly in landing in smooth water—the only place where it was possible—the swifter, low-lying navy boat *had* the advantage of speed while exposed to the enemy's fire. This fire, however, became effective only when the boat was less than two hundred yards from the beach, while now it may be able to stop the boat at ten times that distance. Under such circumstances, the relative speeds of pulling boats are not of much importance. At any rate, the words "likely to be opposed" should be stricken out, with their cheerful indifference and lack of knowledge as to the kind of reception to be expected. The amount of preparation for a likely opposition that could be made in the boats would hardly make any difference. It should be the ship's duty to cover the boats, which in themselves would be helpless, and should be fitted out to land observation party, police, garrison, naval brigade of occupation, or naval brigade prepared to march, etc.

The day of boat operations is by no means past; rather more important now that it is proposed that the defense shall place all its eggs in one basket, all its warlike preparations in harbor-defense vessels and fortifications. The few cruisers that may escape capture for a time will be able to communicate with the beleaguered land only through boats landing on the open coast. The duty of these cruisers is undoubtedly to destroy commerce, but as we have no coaling stations or harbors of refuge, their career will be quickly terminated. Unfortunately, our own commerce is the only one likely to suffer on the seas if such a measure prevails. A cruising fleet of battle-ships would be a moving place of refuge for hunted cruisers.

In siege and blockading operations it will be found that the range of the shore artillery is so great that close observation is rendered too dangerous to be reliable. Occasional landings for the sake of gaining or imparting information will be more valuable than ever. In larger operations it is possible for the boats of a fleet to land on an open coast, fortify their position, and, with the aid of a few ships, hold it until it is made impregnable. There are such points, which, if occupied by an enemy in time, could render the vast fortifications of a port of little value. For, to dislodge the invaders, emplacements must be built for guns heavy enough to drive off the protecting

ships. Otherwise the monitors and harbor-defense vessels must come out and fight at sea—if they can. The subject can only be touched upon to show the advantage that the fleet must have whose boats can select some place for landing on the enemy's shore other than that especially prepared for their repulse. In this connection it must be borne in mind that whereas old-time ships were able to run up fortified rivers and clear the woods with shells from a few slow-firing, smoothbore guns, the modern battle-ship may be said to be equivalent in rapidity and weight of fire to a whole fleet of its predecessors, while in accuracy and range it far exceeds any one of them. The U. S. S. Philadelphia or Baltimore, with less than fifty men on deck to handle the secondary battery, could keep up a fire, which, for range, weight of metal and exact pointing, would be superior to that of ten field batteries of six-pounders.

The best preparation for landing where *likely* to be opposed would be to put the boats in a condition to get over the dangerous space as rapidly as possible. A light inclined shield in the bow would be worth three times its weight of rapid-fire guns, although for this special purpose a Gatling will generally be preferred, on account of its light weight, searching qualities, and the absence of cover on the beach. A field- or boat-gun loses its value on approaching the enemy; it incommodes the crew, and makes it impossible to land except in very quiet water, or some distance from the beach.

In landing on the coast, field-guns should be sent in on balsas or catamarans, when they can be floated safely up to dry land. If placed in the boats, they may swamp or stave them in on striking bottom some distance from the water's edge.

Apart from the *method*, the soundness of a policy permitting the hazardous landing of the crew of a modern cruiser may be questioned. Not only must a larger part of the crew than formerly remain aboard to assist in the care-taking and manipulation of the many apparatus, but the loss of a sensible part of such a crew, though at once replaced by new men, would impair the efficiency of the ship for months to come. This is especially important when it must be acknowledged that, so long as the navy is growing and changing, it can *never* possess a full complement of thoroughly trained men. Few landing operations can be carried out except from the fleet, or rather from its auxiliaries; the lightly armed transports and hospital ships carrying extra men, which should always accompany it. These

transports could be manned by the Naval Reserve, in which manner that valuable branch of the service would gain actual cruising experience and drill without impairing the efficiency of the more important ships through their short terms of service.

With regard to "cutting out," secrecy and despatch are the most important qualities; in case of discovery and failure, the advantage in speed that one pulling boat has over another is immaterial; the result will be equally disastrous. In case, however, the vessel is boarded, one of the worst defects of navy boats makes itself felt; the boat cannot land more than a "corporal's guard" without weakening its crew beyond a safe limit. In landing, even in smooth harbors, few whale-boats could put more than fifteen men on the beach and leave enough to manage the boat properly.

In any case it must be seen that the demand on battle-ships and cruisers for boats able to land men and stores on the open coast will very probably be one of the features of the next war, no matter where the men are obtained or how remote the occasion. For such a purpose the present type of navy boat is useless, its chief defects being lack of seaworthiness and carrying capacity.

While power and seaworthiness are of the greatest importance, exceptional *speed* may in only one rare instance be more important; that of the *transmission of intelligence*, when neither steam launches, sails, nor signals can be used. Even then the boat must be different from the present type; it must have power, freeboard, draft, and narrow beam; something that could be best illustrated by a double-banked gig whale-boat.

For *laying out anchors* in shallow water or breaking seas, two life-rafts may be employed by a variation of Captain Craven's method; or, for that matter, any pair of broad-beamed, light-draft life-boats would serve better than cutters. A single life-boat may be used in the same manner as the old sailing launch, the draining-valve holes or centerboard well taking the place of the bottom funnel.

In *towing*, *warping*, and *kedging*, the large number of men who can be put on a life-boat's oars in any kind of weather without making her loggy or heavy is most important, and may at times save the ship from serious disaster.

The occasion may arise on modern men-of-war in which it will be preferable to *water by boats* day after day for a considerable time, rather than expend coal for distilling. No better boat could be carried for this purpose than a life-boat fitted with end air tanks, and

especially is this true when the choice of a landing place cannot be made.

Boats are also used for carrying stores in tow of a steam launch, lightening ship, and making trips when the launch is not lowered. For these purposes, handiness, large carrying capacity, and ability to keep afloat are the vital characteristics; and yet there is hardly a pulling boat in the navy that has an air tank.

*Abandoning ship.*—It is openly acknowledged that a man-of-war cannot carry a sufficient number of boats to take off her crew in anything but smooth water, and that a certain proportion must be detailed to life-rafts and balsas. It is also admitted that this last nondescript contingent goes far towards spoiling the *drill* of abandon ship, as an indication of the state of discipline and preparedness for emergency aboard ship. It is a feature of the "piping times of peace" that the *outward appearance* is made more important than the actual spirit and purpose of the drill. Divisional competition is a very good thing if *time* is sent to the rear and *thoroughness* is made to take its place.

The question might be asked: Which method would most benefit the actual purpose of this drill? 1st, assign only such a number of men to each boat as would not unduly increase the danger of its loss, and make temporary provision by means of bridges, deck-houses, and life-rafts for the remainder; 2d, do away with the least efficient boat and distribute its weight among all the rest in the shape of increased beam, depth, and sheer, thus increasing the total *safe* carrying capacity. By the substitution of either of these methods the present drill would lose much of its smoothness and precision, but it would be more practical and efficient. Many officers may have noticed that the *operation* of hoisting out boom-boats sometimes litters the deck up more than the *drill* "clear ship for action."

On noting the variety of disasters to which a ship is liable, it is evident that the drill "abandon ship" provides only for that rarest and most merciful of all shipwrecks—that of a ship gradually going down in a calm and placid sea. Instead of doubting the ability of the boats to float their quota, and making the attempt to improve their buoyancy with canvas upper works, they are still further weighted down with heavy cases of *cooked* meats, a large square case, said to contain a boat *stove*, and a Crusoe outfit in a heavy boat box that takes up the space of two or three men. This state of affairs is the accumulation of years of theoretical preparation for a

variety of shipwreck that has never come. Every change in drill has introduced additional safeguards and regulations of precaution without weeding out any that may be obsolete.

There are advantages in being able to stow boat boxes and stoves in the hold, and in borrowing the provisions for the occasion. It is certain, however, that the time spent in procuring these articles, should the actual need ever arise, might cost many lives. Within twenty-four hours after the wreck, the amount of water in the breaker will be the uppermost thought in every man's mind, and if the boat stove is fitted to distill it would be regarded as a priceless treasure. As sailors, with the scuttle-butt always at hand, have no reason to deny themselves in the use of water, as is frequently the case with soldiers, they begin to suffer from thirst, or imagine that they suffer, very quickly.

It would seem advisable when at sea to clear out of the boats all unnecessary rubbish, fit a tank under one thwart as a boat-box, one under another for a boat-still, and a third for provisions. All hands could then fight a fire or leak with good heart to the bitter end. There always seems to be a chance left to call in question the judgment of a commanding officer who has to decide the moment *when preparations for leaving the ship become more important than the attempt to save her*. The number of abandoned vessels found at sea emphasizes this feature of a shipwreck.

With regard to life-rafts. Many are highly recommended, but few seamen have exercised with them, and their peculiarities at sea are not well understood. Their chief recommendations appear to be buoyancy and non-liability to damage from staving or capsizing alongside. An excellent feature of some is that the rubber air-cylinders are encased in canvas ones. The inner one being larger than the envelop—like a football bladder—the outside takes the shock, and if injured, the folds permit the inner case to evade puncture.

On the other hand, almost all descriptions of life-raft require time and careful preparation when all hands are working under great excitement. They are charged with being hard to pull and steer against a wind and sea. Having no freeboard, they will be constantly swept by the waves in breaking seas. It seems certain that if the small balsa furnished the navy is weighted down it will capsize like a barrel in a seaway. Nevertheless, in the majority of ships, the salvation of a portion of the crew can be assured only by a liberal supply of *large* life-rafts; especially since the clearing away of the largest boats will sometimes be impossible.

The *catamaran*, as issued at present, is a sheer waste of weight. Though designed to be very buoyant, it is made of heavy wood, of liberal scantling; it frequently leaks, and has not sufficient freeboard with the crew aboard for pulling in rough water. In a seaway it is certain to be unmanageable and repeatedly swept by the waves. A copper catamaran, with wooden fenders, would be more serviceable, more durable, and less expensive to keep in order.

The *dinghy* is intended to be a handy, safe, and economical boat; it, however, frequently fails in all these qualities. It seems fated to be a source of worry and trouble through its being often unfit for the duty on which it is sent. Being a miniature cutter with the scantling nearly that of the larger boat, its weight is all out of proportion to its freeboard and buoyancy, while its low rails make it a difficult boat to pull even in smooth water. In consequence, the dinghy boys almost invariably form a very unhappy quartette.

Seeing the great growth of the metal-working industries in our navy yards, it would seem not impossible to replace the old type dinghys by others of galvanized iron, with end air-tanks and 15″ freeboard. An efficient 19′ dinghy of this description need not weigh 350 pounds.

In connection with these opinions, it is well to consider in detail the demands likely to be made on a ship's boats for life-saving.

These may be divided into two classes, with subdivisions, as follows:

I. In case of the loss of the ship, when provision must be made for the rescue of all hands.

1. Loss by fire, when all hands fight the fire to the last. The loss of the Bombay is an instance where the fire was fought too long, it being impossible to get all the people off the ship.

2. Founders slowly, from collision with other vessels, ice, injuries received in storm or battle, etc.

3. Founders quickly, from various unexpected causes.

4. Wrecked on the coast.

5. Wrecked on outlying shoals or reefs.

And all these disasters, and others unforeseen, take on different shapes and require to be met by different treatment according as they occur by night or day, in rough or smooth weather, in the presence of friends and succor, or alone. The last two subdivisions have in addition as many peculiarities as the coasts on which ships are wrecked.

II. Saving life from the ship.

1. Man overboard under way or in port.

2. Assistance to a vessel in distress.
3. Taking people off a wreck at sea, on a shoal, or on an island.
4. Communication with the shore.

Again, all these important conditions may vary in many ways.

It thus appears that there is really a greater variety of imperative duties demanded of ship's boats for saving life than for all other duties combined. That such demands are made infrequently is hardly the case, considering the long list of minor casualties during the past few years. Even if they were rare, that is no reason why they should be ignored. It would be as sensible for a ship to go to sea with sub-caliber practice-barrels instead of her heavy guns; a much finer drill may be had with the former, perhaps, than with the latter. It is a noble thing to save life, and the qualities of men and boats necessary to success in that would compel success in all other duties. Let seaworthiness be carried to the highest point of excellence in the *navy boat.* Casual routine duties should have no influence in diminishing the peculiar efficiency of such a boat. Comfort will certainly be improved, but the convenience in petty things, and pride in appearance, should no more be allowed to interfere with the grand essentials of a life-boat than they do with the art of war itself.

It is asked that the presence of objections to the proposed change shall not condemn it before due weight is assigned to the related advantages, nor that an advantage shall be rejected as valueless because it is only partially obtained.

Objections to the proposed boats may be *functional* or *materialistic, active* or *latent.* The first at once limits efficiency; the second imposes conditions independent of use; as of cost, care, size, weight, etc.

All that is suggested is that it would be advantageous to exchange a few functional and active objections, of which navy boats have plenty, for a few materialistic and latent ones; the only ones in fact that appear in a life-boat.

There is one last view of the subject, that is, the effect of the possession of good, seaworthy boats, on the tone of the navy at large. The most stirring professional experiences of most officers, calling for all their energies of mind and heart, may be unhesitatingly declared to have occurred in their encounters with the forces of nature. It can almost be said that the exigencies of a battle cannot make as great a demand on the nerve and courage of officers and men as a great storm. Between the old sailing-master and the modern commander there is much difference. The former depended solely

upon the power of his crew and his own knowledge to prevail against the storm. A life of this sort made seamen self-reliant, courageous, and persevering; sea fights were fought out to the bitter end, until one of the combatants no longer had the power to strike a blow. In modern times, with the introduction of steam and various labor-saving mechanisms, it is apparent that much of the success of a naval battle must depend upon forces to which no appeal can be made, that the slightest neglect of some principle or precaution in the engine room may throw the fate of the battle adversely, or at least seriously jeopardize success. But this is not all; under the circumstances, it is evident that with the increased range of possibilities, an increased power of adaptation is necessary in the men who fight. Evidently, therefore, it will be detrimental rather than beneficial to make many of these men specialists, and thus, by absorbing the powers of the seaman in any one direction, limit their adaptability to others. In fact, the power of adaptation of the men on deck never was more important than it is at present.

There are many points of isolated and varied responsibility on any one of the new cruisers. The enormous demand for ammunition of all calibers and description, each variety requiring its own precautions and treatment, necessitates a very large number of well trained men possessing greater intelligence and breadth of knowledge than in the past. Considering how much greater the cruiser's powers of offense are than those of defense, it cannot be hoped that an action between them will be even initiated without serious loss. For this reason the battery must be served by men of sufficient intelligence to master the duties and stations of a very flexible quarter bill—a bill that will permit either concentration or scattering of forces, to continue the fire of important guns to the last, or to distribute the crews of those disabled. In fact, every minute of action may annihilate whole gun's crews or mechanisms, and such catastrophes should be provided for in the bill. It may at any time be deemed advisable to withdraw the crews of exposed guns, or guns difficult to supply with ammunition, in order to secure a more rapid fire from others less exposed. These reasons alone seem sufficient to indicate how necessary it is that the fighting portion of the crew should be *homogeneous* and instructed in the essentials of the service of *every* part of her battery. It would also seem criminal to expose on the deck of a cruiser in action a single man more than necessary to make the best use of her fighting powers. The act of calling away

from each shielded gun's crew one man for duty in connection with boats or spars must be not only at the expense of rapidity of fire but at the expense of life.

The real problems of naval warfare lie in the proper development and combination of a ship's powers of offense and defense as a whole, and not in the details of the manipulation of any of her separate mechanisms, however intricate they may be. A gun's crew may drill well in a month, yet it may be three years before the ship as a whole can make the best use of her powers.

A modern ship can give a good account of herself only when fought by an intelligent, plastic crew that will not be at a loss to know how to fight when the exigencies of battle have rendered their paper billets obsolete. To attain this state of training with young Americans, it would seem a good plan to form small groups with general instructions. As soon as battle had broken up the finished drill organizations, the groups would take their place. In this way individual experience and adaptability would not be paralyzed by too narrow restrictions. The fact is, the modern battery and its fire tactics must rely upon the *unbidden help* of every one on deck, in the same manner that the old sail and spar evolutions did.

With regard to the seaman. The modern battery, though requiring more precision and permitting many more combinations than that of thirty years ago, is a bad exchange, as an educator, for sails and spars. It is more intricate at first, but once mastered, the treatment of its parts is governed by simple and invariable laws. On the other hand, Nature has a myriad of phases; she is always grand and courage-provoking. A mechanism, to be satisfactory, must always be the same. At times it may be utterly unreliable, or unintelligible, until the cause of derangement is discovered. Were the navy obliged to depend on battery drills alone, or machine drills of any sort, for the training of its *personnel*, the result could not help but be deterioration.

By deterioration is meant simply that the mind, which in the most ordinary duties of the sailor has considerable range of judgment, is limited in the management of machines by a few narrow thumb-rules. The underlying principles will appear to the most intelligent, but beyond and back of it all there must always remain much that cannot be understood or appreciated by any but the specially educated. In fact, however complicated the machinery and ingenious the mind that devised it, only those features which are concerned in its care

and manipulation will, with rare exceptions, enter the life of the enlisted man. These principles are naturally made as simple and distinct as possible, in order that they may not require more of the seaman's attention than their relative importance demands. Continual gun or machine drill for an entire cruise can do no more than turn the thinking seaman into an obedient puppet.

To many, it would seem that the days of the seaman are gone; that he should be replaced by a certain proportion of skilled mechanicians and common laborers. But with such a change the very vitality of the sea-fight is lost. A sailor may become as much of a machinist as is required, but as soon as this work takes the nature of a steady vocation, he seems to become less a seaman.*

Seamanship is by no means dependent upon sails and spars; these gave only the best means of its exhibition. All that has been and always will be the best part of the seaman—that readiness of resource and instant adaptation; above all, the quick comprehension of the most pressing need—is of more value now than ever. The question is, how can it best be fostered and developed?

In no way could these qualities be better studied than in boat work—not the boat work of smooth water and a gentle breeze, when half the crew are gradually lulled asleep, but the boat work that makes each man alert for his own safety's sake; the boat work that speedily puts in the coxswain's box a man who can handle the crew as well as the boat; that makes each man there respect himself and his neighbor because their skill and nerve are so essential to the general welfare.

The writer has no thought of encouraging foolhardiness, or of stimulating men to sacrifice themselves, however heroically, where nothing can be gained. On the other hand, he would attempt to cultivate the judgment that discerns the impossible, however much it may be regretted. It is no impeachment of the courage of seamen to say that the more they know of the difficulties of a rescue at sea, the more commendable will be the act of volunteering.

* Machinery covers the earth and is as varied as the requirements of mankind. A machinist must know and do many things, but he knows that, in so broad a field, he owns his title only so far as his knowledge is *exact*. Hence most of his life's energy is expended within narrow limits; sometimes he merely works for the sake of the work without a thought of its ultimate purpose. His vocation is a valuable one wherever exact results are required; but for fighting a very different character is wanted—a character that knows no rule of spirit or material to prevent success.

When to lower a boat in rough weather at sea, just as when to attempt the passage of surf, is a question dependent upon many ever differing conditions. Among these, any one of the three most important—experience of crew, qualities of boat, and state of sea—must outweigh all the rest. To the commanding officer, one man's life should mean no more than another's, and the staking of six or eight for one could be justified only when success proved that the circumstances made the odds more favorable. For, however much sentiment may pervade the action and influence the decision, far away in cool and quiet judgment the deed will be discussed and its advisability admitted or denied in a very different spirit.

Individual heroism or *esprit de corps* may lead to a contempt of the judgment that would weigh the chances of success, so that it is no pleasant task to restrain them. Yet a barren sacrifice of brave men should never be permitted.

## APPENDIX.

### "JAMES BEECHING, BOAT-BUILDER, GREAT YARMOUTH.

*Description.*—The body of this boat is of the form usually given to a whale-boat—a slightly rounded floor, sides round in the fore and aft direction, upright stem and stern post, clench built, of wainscot oak, and iron fastened.

Length extreme, 36′; of keel, 31′; breadth of beam, 9½′; depth, 3½′; sheer of gunwale, 36″; rake of stem and stern post, 5″; straight keel, 8″ deep. The boat has seven thwarts 27″ apart, 7″ below the gunwale and 18″ above the floor; pulls 12 oars, double banked, with pins and grommets. A cork fender 6″ wide by 8″ deep runs around outside at 7″ below the gunwale.

Extra buoyancy is given by air cases 20″ high in the bottom of the boat under the flat; round part of the sides, 24″ wide by 18″ deep, up to the level of the thwarts, leaving 10′ free amidships; and in the head and stern sheets, for a length of 8½′, to the height of the gunwale; the whole divided into compartments and built into the boat; also by the cork fenders. Effective extra buoyancy 300 cubic feet, equal to 8½ tons. For ballast a water-tank divided into compartments, placed in the bottom amidships, 14′ long by 5′ wide and 15″ high, containing 77 cubic feet, equal to 2¼ tons when full, and an iron keel of 10 cwt. Internal capacity of boat under the level of the thwarts, 176 cubic feet, equal to 5 tons. Means of freeing the boat of

# LIFE BOAT, BY JAMES BEECHING, GT. YARMOUTH

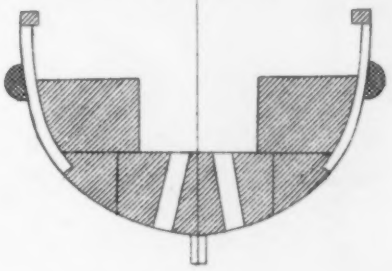
SUBMITTED TO COMPETE FOR THE NORTHUMBERLAND PREMIU

AIR.

WATER.

CORK.

SECTION AT 3.



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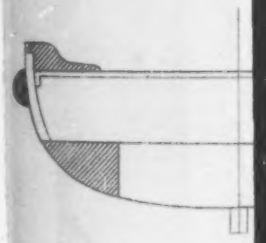
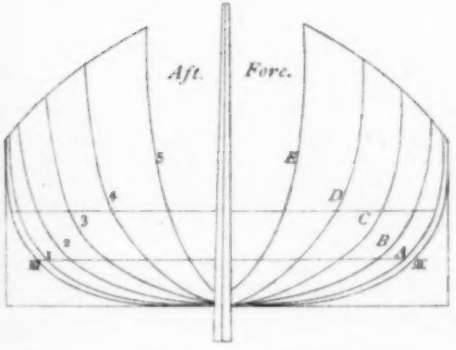


BODY PLAN.

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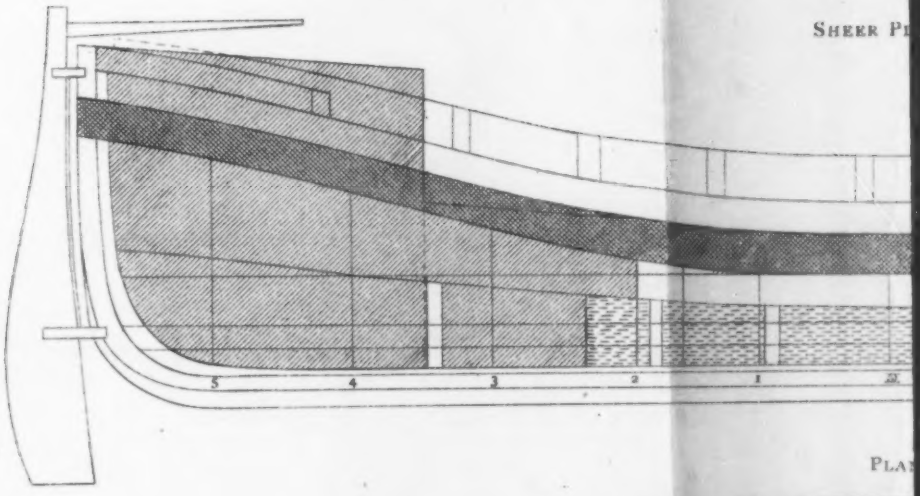


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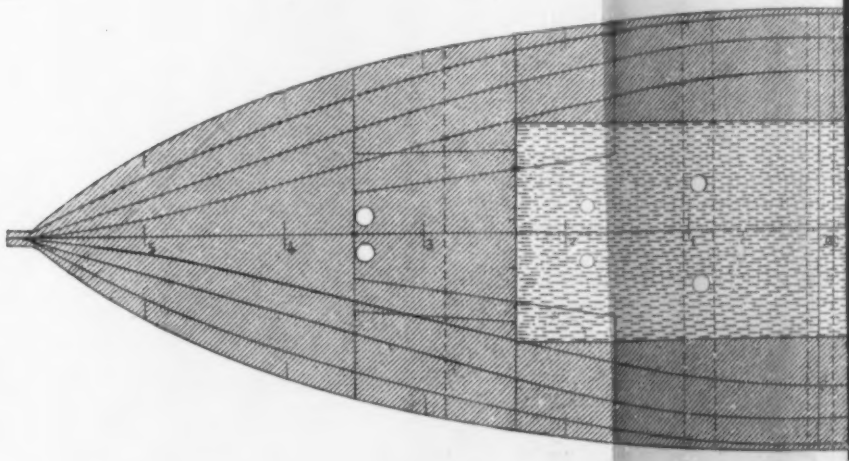


30 25 20 15

## PRINCIPAL DIMENSIONS.

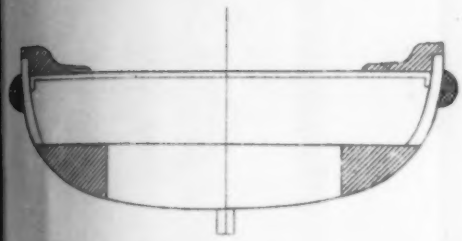
| | |
|---|---|
| *Length extreme* | 36 *ft.* 0 *ins.* |
| *Length of keel* | 31 0 |
| *Breadth of beam* | 9 6 |
| *Depth* | 3 6 |
| *Sheer of gunwale* | 3 0 |
| *Extra buoyancy, air, 300 cubic ft.* | 8½ *tons.* |
| *Internal capacity up to the level of the thwarts* | 5 |
| *Area of delivering tubes* | 276 *sq. ins.* |
| *Proportion of delivering area to capacity* | 1 *to* 6 |
| *Weight of boat or displacement* | 3½ *tons.* |
| *Ballast, 2 tons of water and iron keel ½ ton,* | 2½ |
| *Draft of water with 30 men on board* | 2 *ft.* 2 *ins.* |
| *No. of oars double banked* | 12 |
| *Clench-built of oak and iron-fastened.* | |
| *Rig of boat* | 2 *lug sails* |
| *Cost complete* | £250. |

ISAAC FREEDENWALD, PHOTO-LITH., BALTO.

# ING, GT. YARMOUTH.

NORTHUMBERLAND PREMIUM.

SECTION AT O.



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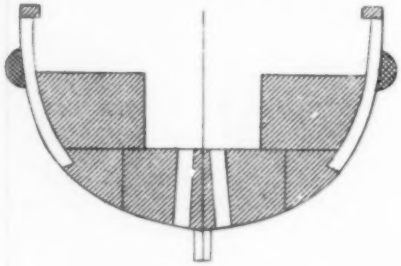
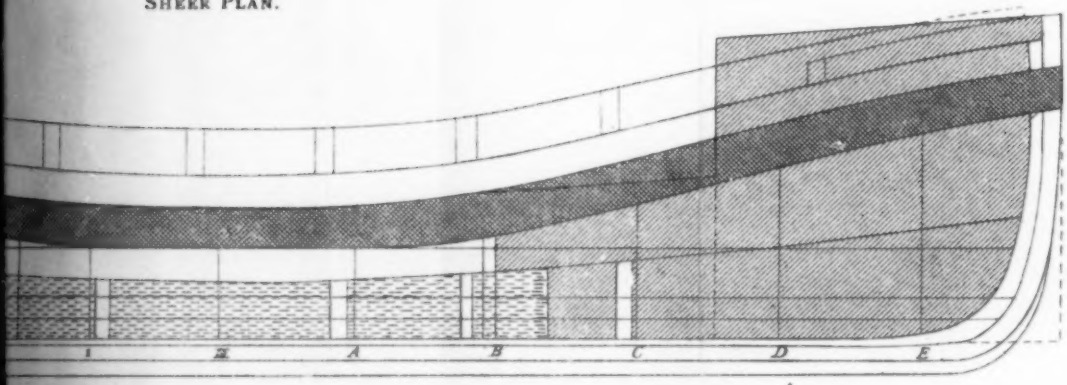
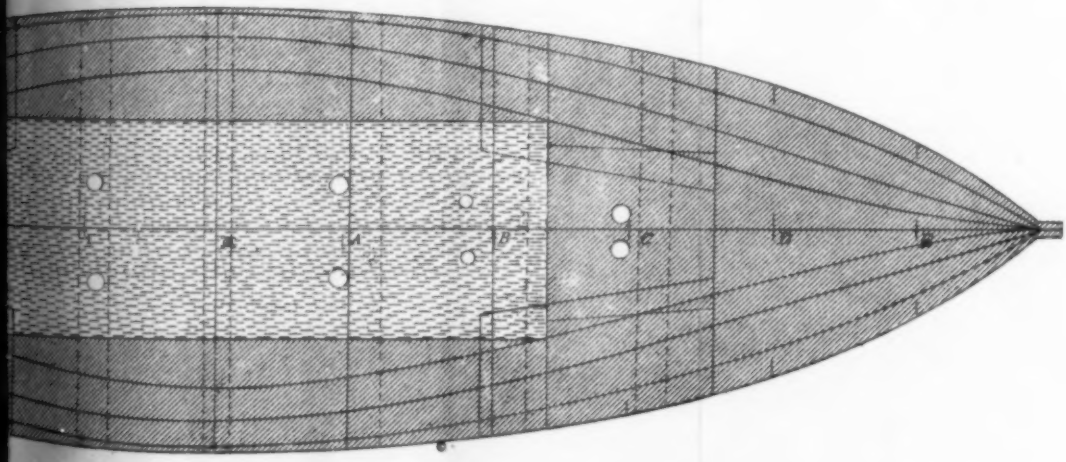


SHEER PLAN.




PLAN.




15 10 5 4 3 2 1 0 *Scale* $\frac{1}{4}$ *in. to a foot.*

water, tubes through the bottom, 8 of 6″ in diameter and 4 of 4″ in diameter; total area, 276 square inches, which is to the capacity in the proportion of 276 to 176, or as 1 to .64. Provision for righting the boat if upset, 2¼ tons of water ballast, an iron keel, and raised air cases in the head and stern sheets. Rig, lug foresail and mizzen; to be steered by a rudder; no timber heads for securing a warp to. Draft of water with 30 persons on board, 26″. Weight of boat, 50 cwt., of gear, 17 cwt.; total, 67 cwt. Would carry 70 persons. Cost, with gear, £250.

*Remarks.*—The form given to this boat would make her efficient either for pulling or sailing in all weathers; she would prove a good sea boat, and in places such as Yarmouth, where there are always plenty of hands to launch a boat, her weight would cause no difficulty. By means of the raised air cases placed at the extremes, the absence of side air-cases for a length of 10′ amidships, the introduction of 2¼ tons of water ballast into her bottom when afloat, and her iron keel, this boat would right herself in the event of being capsized; although from the form given to her it is highly improbable that such an accident should occur.

A passage should be left in the air cases to approach the stem and stern, for on many occasions the only way in which a life-boat can go near a wreck is end on, when the crew of it must be received either over the stem or the stern. The keel, 8″ deep, however favorable for sailing, for steadying her in a seaway, and for aiding her in righting, would be a disadvantage in beaching and would render the boat more difficult to turn in case of wishing to place her end on to a heavy roller coming in. The area of the delivering valves is large in proportion to the internal capacity, and would rapidly free the boat of water, down to the level of her draft, which with her crew on board would not be to less than a depth of some inches above the flow. The air cases are built into the boat, which renders them liable to accidents; if this were remedied and her internal capacity reduced, a 30′ or 32′ boat built on similar lines, with her internal fittings slightly modified, would make an efficient life-boat, adapted for many parts of the coast."

Order of merit, 1. Mark, 84.

"GEORGE PALMER, NAZING PARK, WALTHAM ABBEY, ESSEX.

*Description.*—The form of the midship body of this boat is that of a whale-boat, with upright stem and stern, rising floor, sides straight

in a fore and aft direction, clench built, of elm and fir, and copper fastened.

Length, extreme, 26′; length of keel, 24′; breadth, 6¾′; depth, 3¾′; sheer of gunwale, 20″; straight keel, 3″ deep. The boat has 5 thwarts, 24″ apart, 9″ below gunwale, and 22.5″ above floor; pulls 5 oars, single banked, with tholepins. A cork fender 4″ wide and 4″ deep extends along both sides close up to the gunwale, but does not reach within 18″ of the stem or stern.

Extra buoyancy is obtained by detached air cases of wood, 18″ square, along the sides up to the level of the thwarts, and in the bow and stern sheets up to the height of the gunwale, the whole divided into 12 compartments; also by the cork fenders. Effective extra buoyancy, 82 cubic feet, equal to 2½ tons. No ballast. Internal capacity up to the level of the thwarts, 62 cubic feet, equivalent to 1¾ tons. No means of freeing the boat of water except by bailing. Provision for righting the boat if capsized, raised air vessels at each extremity. To be steered by a rudder. There are two timber heads for warps, one on each bow; wash-strakes around the head and stern sheets, and life-lines along the gunwale. Draft of water with 22 persons on board, 15″. Weight of boat, 10 cwt., of gear, 5 cwt.; total, 15 cwt. Would carry 20 persons. Cost £75.

*Remarks.*—This boat would pull well, is light for transporting along a beach, could readily be manned at any station on the coast, has light draft of water, small internal capacity for holding water up to the level of the thwarts, and detached air cases, which would preserve them from the risk of being stove alongside a wreck; all of which are good points in her favor. She has timber heads forward for securing a warp to, but none on the quarter, and plenty of life-lines.

The boat would not right herself if capsized, and the raised air-cases at each end would prevent any approach to either extremity within 4½′, which might prove extremely inconvenient in case of having to receive a wrecked crew on board at the head or stern of the boat, which not uncommonly occurs. The boat is narrow for her length, and her rising floor is not favorable for taking a beach.

This model has been generally adopted by the Royal National Institution for the preservation of lives from shipwreck, and several similar boats are, it is believed, placed around the coasts, as in the Isle of Anglesey and elsewhere in Wales, which, it is said, have been the means of saving many lives."

Order of merit, 8. Mark, 70.

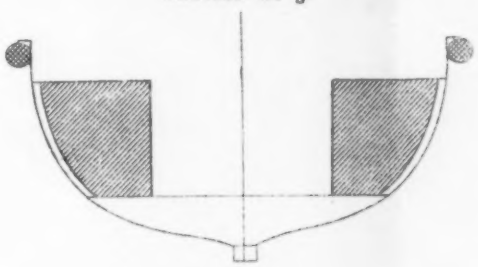
# LIFE BOAT, BY GEORGE PALMER, ESQ., NAZING F

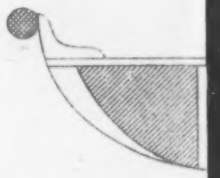
SUBMITTED TO COMPETE FOR THE NORTHUMBERLAND PREMI

AIR.

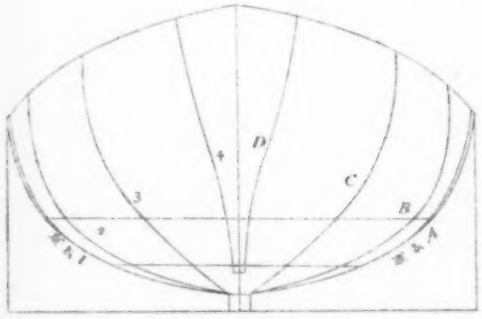
CORK.

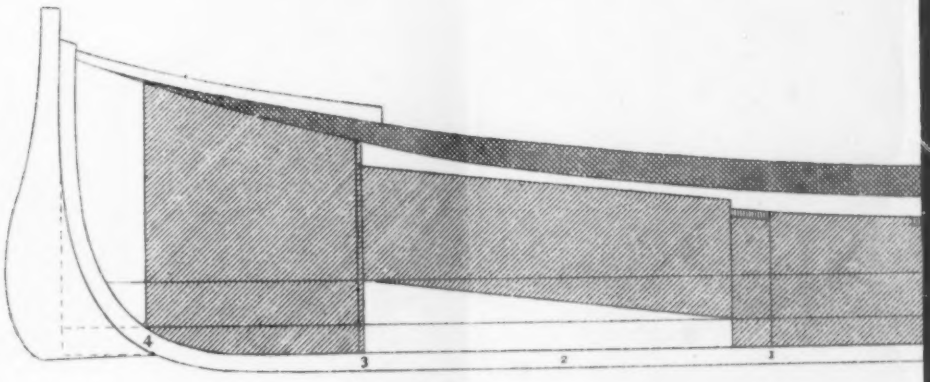
SECTION AT 3.





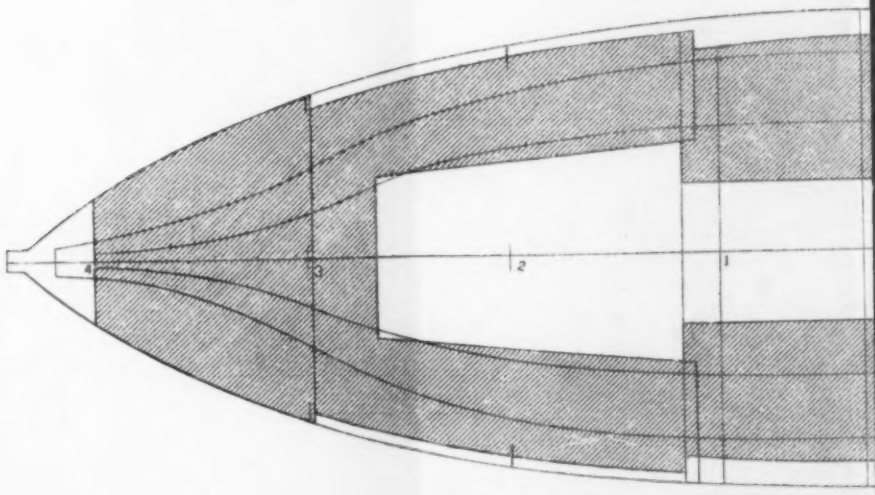
BODY PLAN.




## PRINCIPAL DIMENSIONS.

| | |
|---|---|
| *Length extreme* | 26 *ft.* |
| *Length of keel* | 24 |
| *Breadth of beam* | 6¾ |
| *Depth* | 3½ |
| *Sheer of gunwale* | 20 *ins.* |
| *Extra buoyancy, air,* 82 *cubic ft. equal to* | 2½ *tons* |
| *Internal capacity up to the level of the thwarts,* | 1¾ |
| *Area of delivering valves* | *none.* |
| *Proportion of delivering area to capacity* | |
| *Weight of boat or displacement* | 15 *cwt.* |
| *Ballast* | *none.* |
| *Draft of water with* 20 *men on board* | 15 *ins.* |
| *No. of oars single banked* | 5 |
| *Clench-built of elm and fir, copper-fastened.* | |
| *Rig of boat* | *none.* |
| *Cost complete* | £75. |

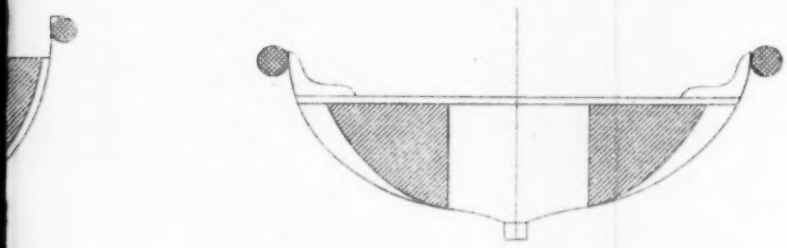



ISAAC FRIEDENWALD, PHOTO-LITH. BALTO.

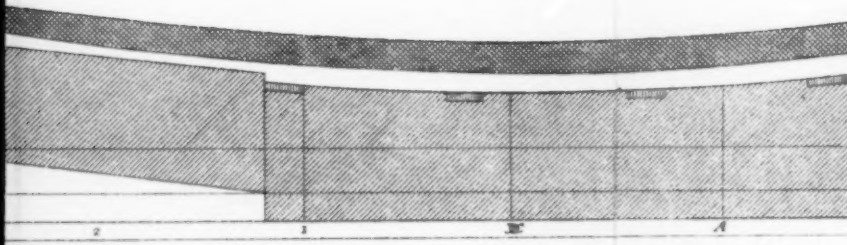
# GEORGE PALMER, ESQ., NAZING PARK, ESSEX.

COMPETE FOR THE NORTHUMBERLAND PREMIUM.

SECTION AT O



SHEER PLAN.

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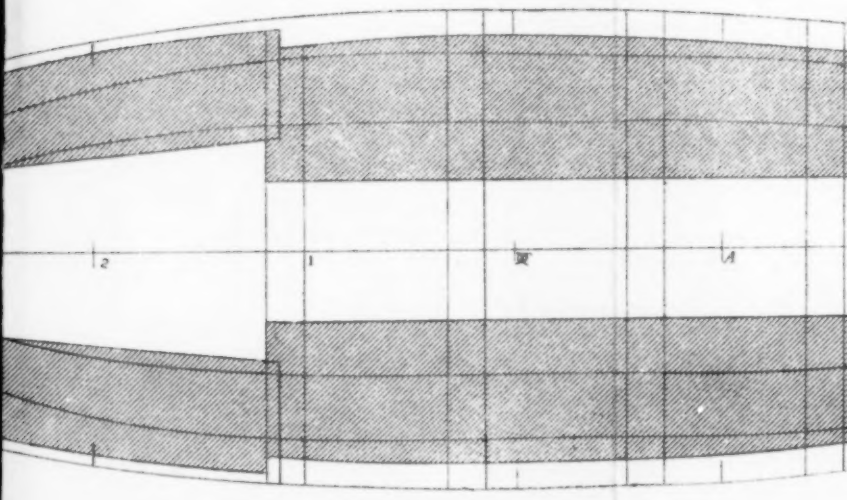


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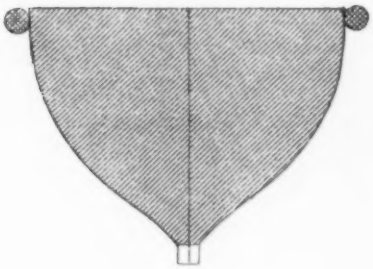
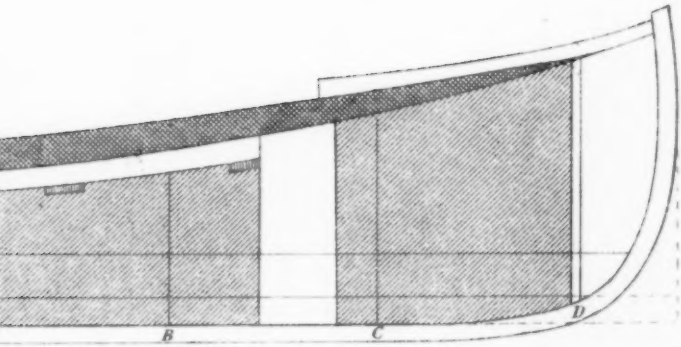
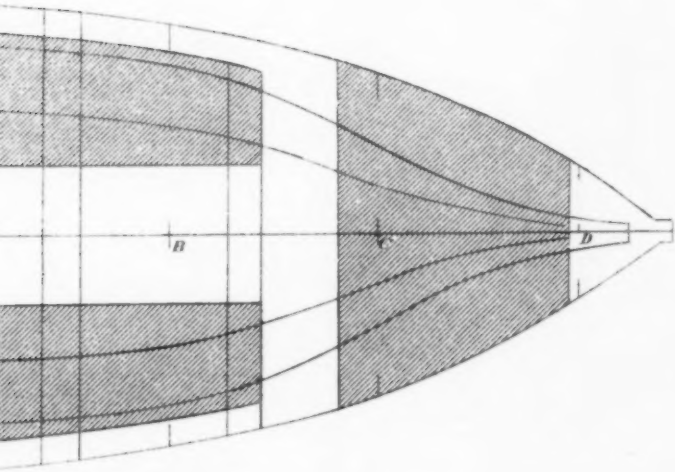
SECTION AT C.





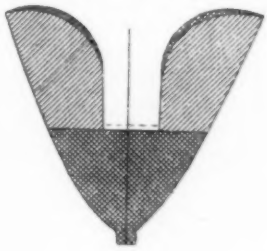




5 0 *Scale $\frac{3}{8}$ in. to a foot*

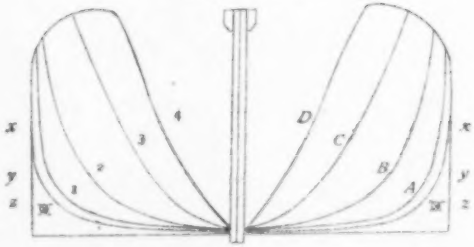
AIR.

CORK.

SECTION AT 4.



BODY PLAN.




## PRINCIPAL DIMENSIONS.

| | |
|---|---|
| *Length extreme* | 30′ 0″ |
| *Length of keel* | 24′ 0″ |
| *Breadth of beam* | 8′ 9″ |
| *Depth to underside of keel* | 3′ 6″ |
| *Sheer of gunwale* | 2′ 1″ |
| *Extra buoyancy, cork and air, equal to* | 3 *tons.* |
| *Internal capacity up to level of thwarts* | 4 |
| *Area of delivering valves* | 300 *sq. ins.* |
| *Proportion of delivering area to capacity* | 1 *to* 5 |
| *Weight of boat and fittings or displacement* | 38 *cwt.* |
| *Ballast iron band, equal to* | 3 |
| *Draft of water with* 30 *men on board* | 16″ |
| *No. of oars double banked* | 10 |

*Diagonal-built of rock elm and copper-fastened.*

*Rig of boat, a fore and mizzen lug sail.*

*Cost complete*

ISAAC FRIEDENWALD, PHOTO-LITH. BALTO.

# LIFE BOAT, BY JAMES PEAKE, ESQ., WOOLWICH,

*Assistant Master Shipwright, H. M. Dockyard.*

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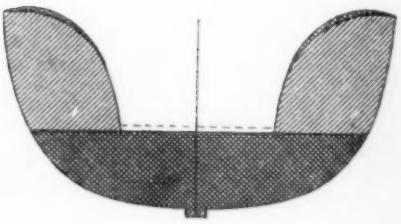

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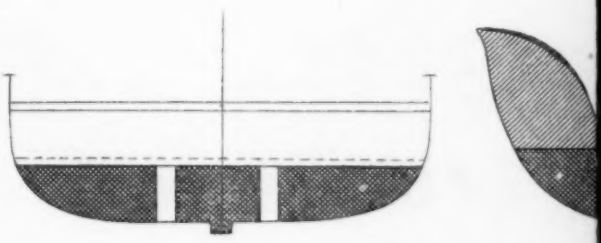

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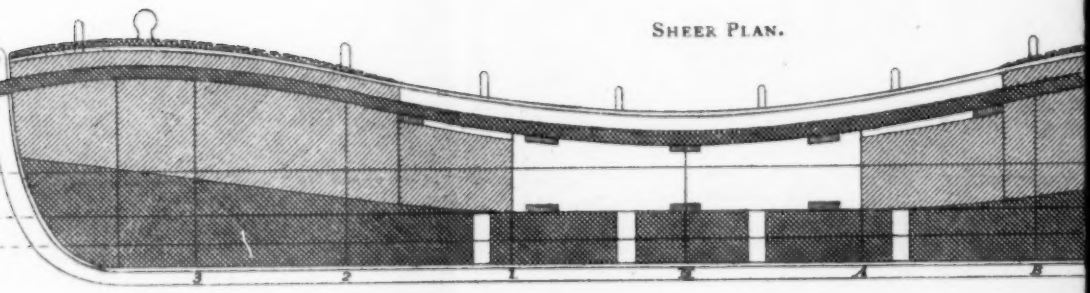

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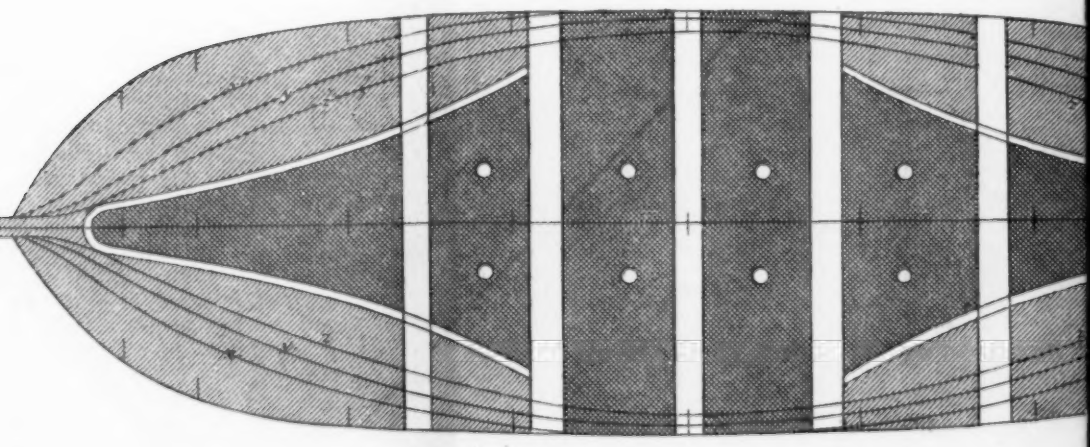

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# LIFE BOAT, BY JAMES PEAKE, ESQ., WOOLWICH,

*Assistant Master Shipwright, H. M. Dockyard.*

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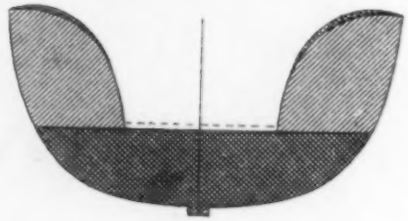

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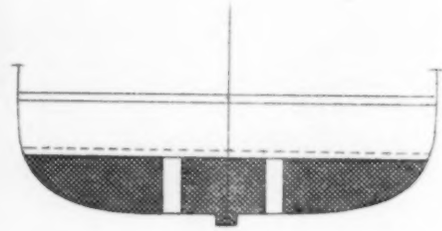

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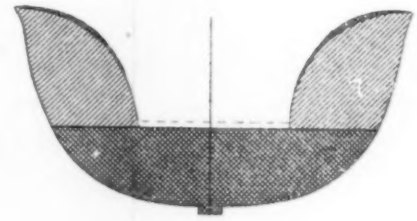

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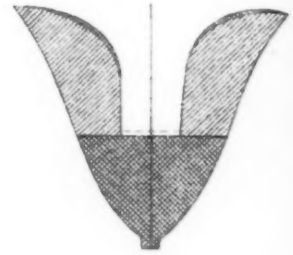

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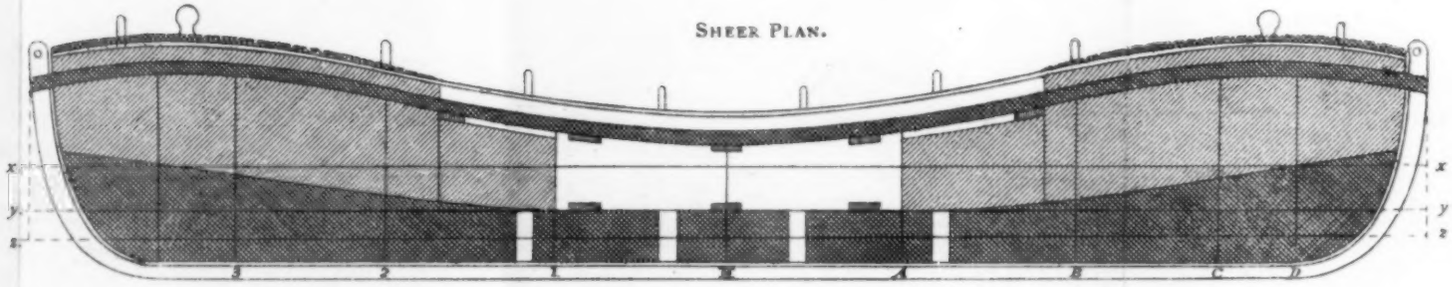


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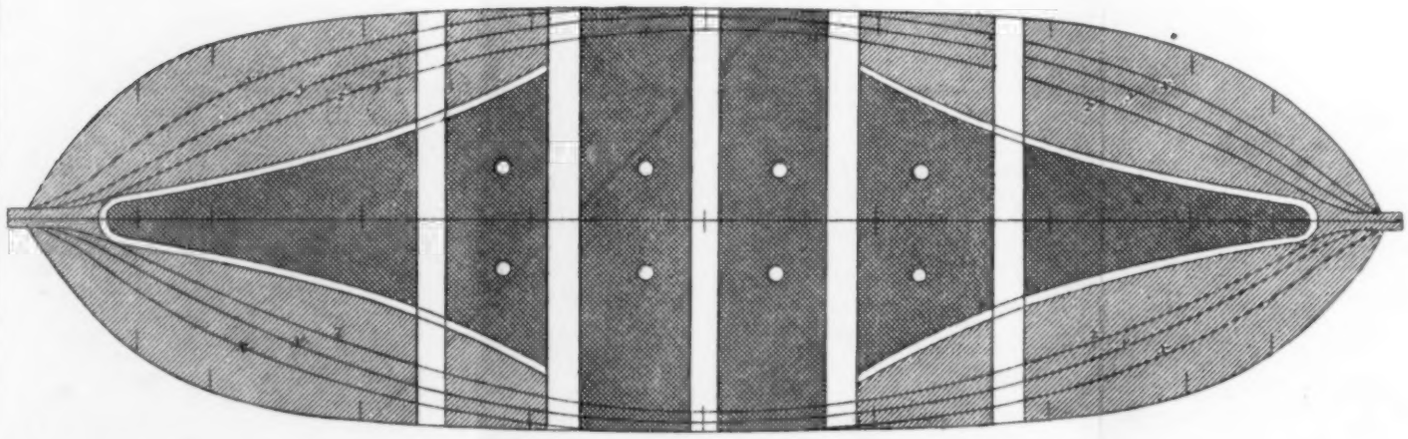


"JAMES PEAKE, ASSISTANT MASTER SHIPWRIGHT IN H. M.'S DOCKYARD, WOOLWICH.

*Description.*—The form of this boat is that usually given to a whale-boat, having a long flat floor amidships, sides straight in a fore and aft direction, raking stem and stern post, diagonally built of two thicknesses of rock elm, and copper fastened.

Length extreme, 30′; length of keel, 24′; breadth of beam, 8¾′; depth, 3½′; rake of stem and stern posts, 6½″ in a foot; straight keel 4″ deep, and bilge pieces with holes in them to lay hold of on each side on the bottom. The boat has five thwarts, 7″ wide, 28″ apart, 7″ below the gunwale and 15″ above the floors, pulls 10 oars, double banked, with pins and grommets. A fender of cork, 4″ wide by 2½″ deep, extends fore and aft at 4″ below the gunwale.

Extra buoyancy is obtained by cork placed the whole length of the boat under the flooring to a height of 12″ above the keelson, and by light cork or detached air-cases in the head and stern sheets up to gunwale height. Effective extra buoyancy, 105 cubic feet, equal to three tons. A light water-tight deck will be placed on the cork to protect it, and above that a light grating. For ballast, the weight of the cork in the bottom and an iron keel of 5 cwt. Internal capacity for holding water up to the level of the thwarts, 140 cubic feet, equivalent to four tons. The means of freeing the boat of water are by eight tubes of 6-inch diameter through the bottom, and six scuppers through the sides at the height of the flooring, giving a total delivering area of 300 square inches, which is to capacity as 1 to .5. The provision made for righting the boat consists in the sheer given to the gunwales, raised air vessels or cork in the head and stern sheets, and the ballast arising from the weight of cork in the bottom, and the small iron keel. A passage 18″ wide up to within 2′ of the stem and stern is left between the raised air cases in the extremes, and the top of the cases is protected by a layer of cork. Rig, fore and mizzen lug-sail. To be steered by a sweep oar at either end. Timber heads for warps are placed at each bow and quarter, and a roller for the cable in the stem and stern post head. A locker under the flooring amidships for the anchor and cable to be secured down to the keelson, and covered with a water-tight scuttle.

A life-line fore and aft at a foot below the gunwale, and short knotted life-lines to be hung over the sides at each thwart. Draft of water with 30 men aboard, 16″.

Weight of boat and fittings, 38 cwt. Would carry 60 persons.

Actual cost if built in one of H. M.'s dockyards: Materials, £40; labor, £45; total, £85.

*Remarks.*—It is anticipated that this boat, from her form, will pull fast in all weathers, and be fully able to contend against a head sea. She would sail well, and from her flat and long floor and straight sides would have great stability and prove a good sea boat. From a slight fulness in her entrance and flaring bow aloft, she will beach well, and leave the shore through breakers in safety. It is not probable that a boat of this form could be readily upset; but should such an accident occur, the sheer of gunwale, raised air-cases in the extremes, weight of cork in the bottom, and iron keel would cause her to right herself. The area of the delivering valves is ample, and the boat would readily free herself of all water above the flooring when she has 30 persons on board. In the possible case of the tubes through the bottom being choked by the boat grounding on a bar or bank, there are sufficient scuppers provided in the side to free the boat of water.

As the greater part of the buoyancy is obtained by cork, all liability to accident is avoided. It is proposed to use light fisherman's cork (of about 12 pounds weight to the cubic foot) for the righting power in the head and stern sheets, if not found too heavy; otherwise detached air-cases, divided into compartments to be formed of a layer of gutta-percha between two thin boards. The diagonal mode employed in building gives great strength; the planks are of one length from gunwale to gunwale, and the keel brought on the bottom, so that if it were knocked away it would not damage the boat.

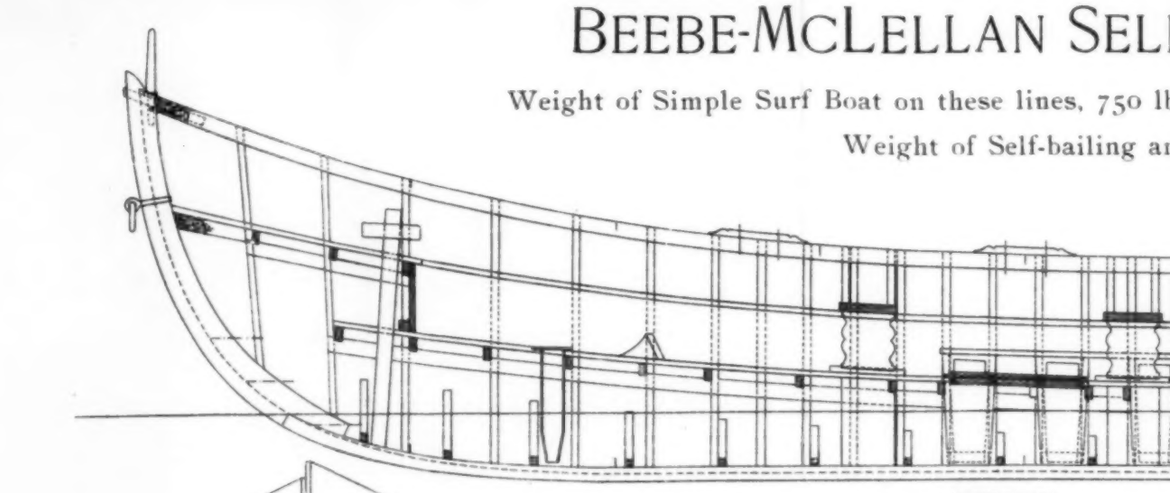
The builder claims no merit for his design beyond that of having selected the best points from the several models selected for competition, and having combined them in a form as shown in Plate III., which appears to him better adapted to the general purposes of a life-boat than any he has hitherto seen. It is proposed to place the boat, as soon as completed, at Cullercouts, on the coast of Northumberland, two miles north of the entrance of the Tyne, as a station well adapted for testing her capabilities."

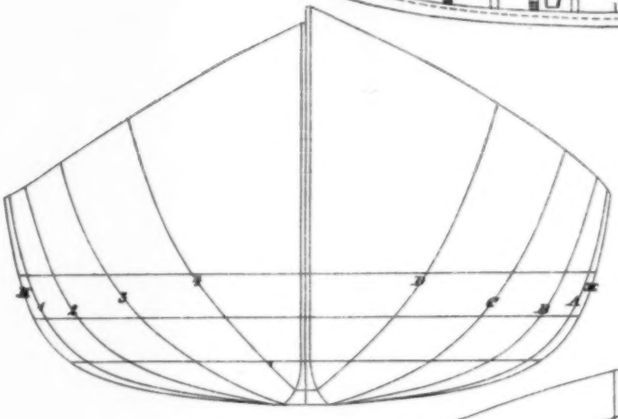
Attention is called to the way in which the gunwale sheer is discontinued at bow and stern as soon as the ends become too fine for such sheer to be any use for buoyancy. Another interesting point is the extreme cheapness with which the boat was built at a government dockyard. In 1852, this boat was completed. It is stated in an instructive treatise on saving life at sea, issued by the Secretary of

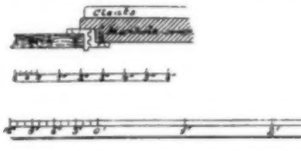
# BEEBE-MCLELLAN SEL

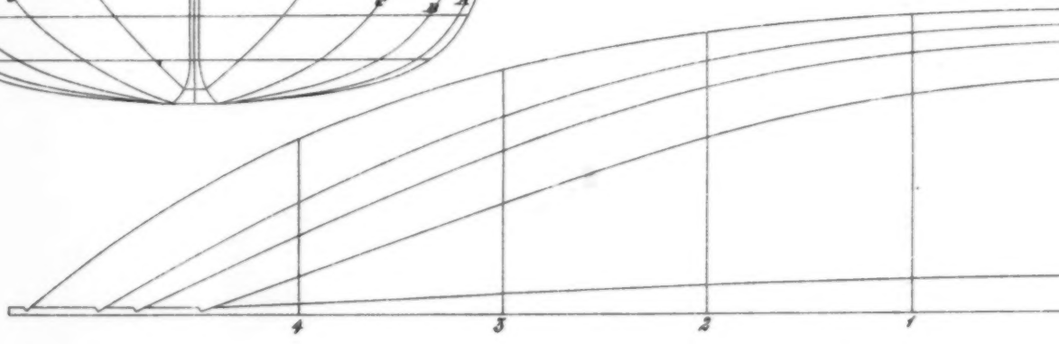
Weight of Simple Surf Boat on these lines, 750 lb

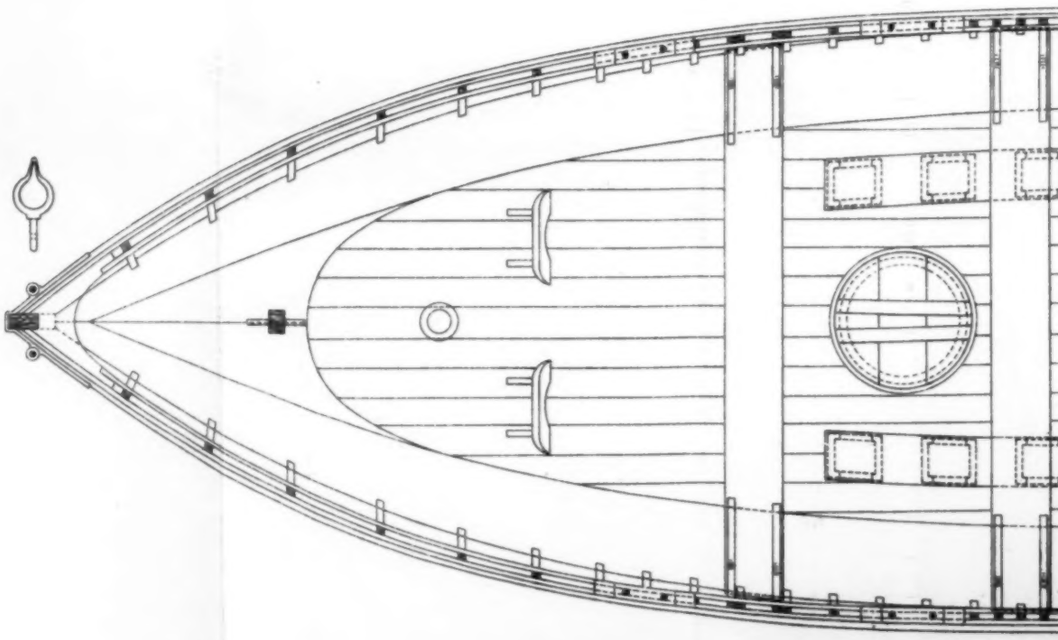
Weight of Self-bailing ar







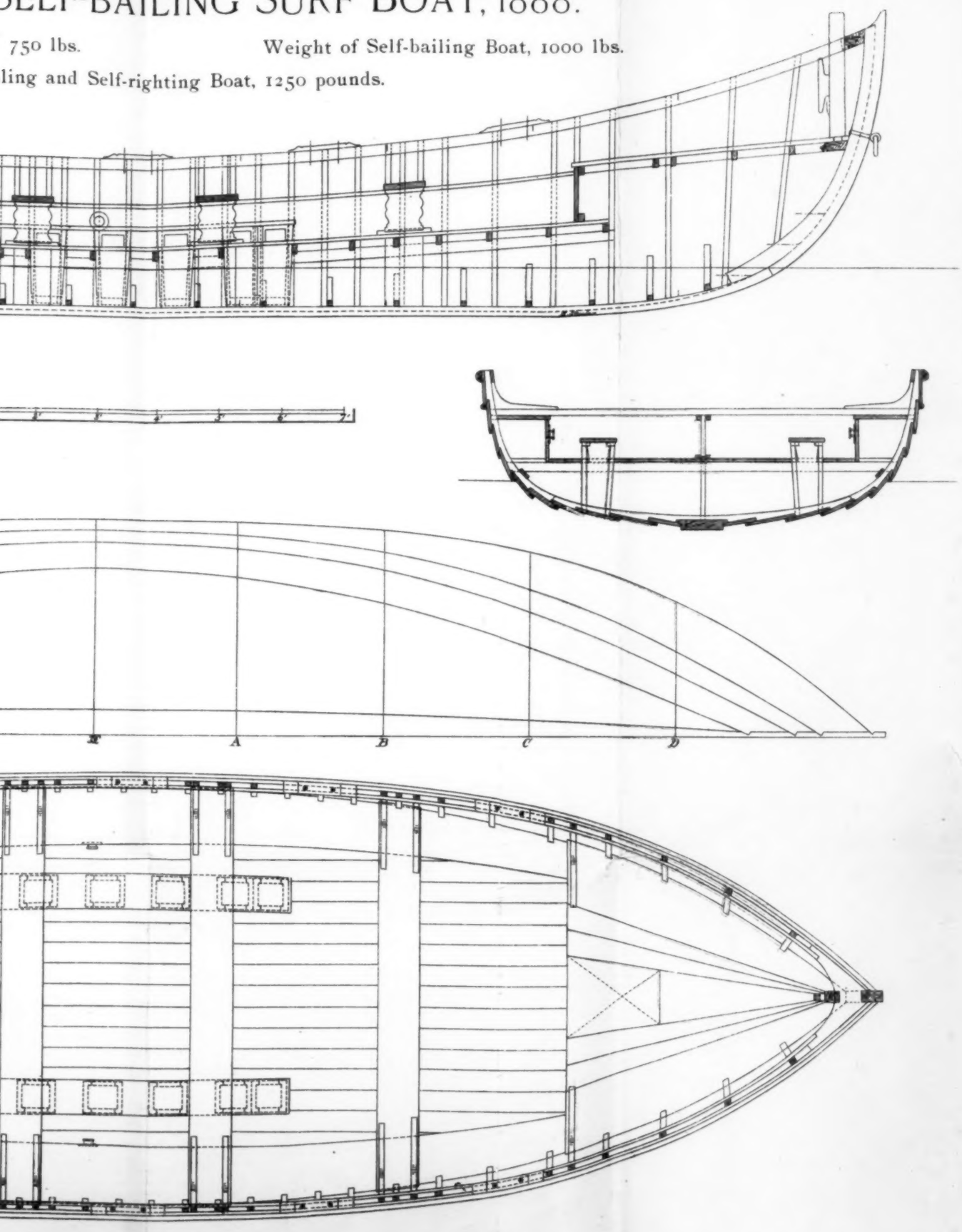


# SELF-BAILING SURF BOAT, 1888.

750 lbs. Weight of Self-bailing Boat, 1000 lbs.

ling and Self-righting Boat, 1250 pounds.




ISAAC FRIEDENWALD, PHOTO-LITH., BALTO.

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the National Life Boat Institution, that its beam was 8′ instead of 8¾′, that it was furnished with side air-tanks, and air-tanks under the thwarts; draft, 15″; with crew, 18″; iron keel of 7 cwt. (instead of 5 cwt.); and weighed 46 cwt. instead of 38 cwt. "When she was hove keel up by a crane, she righted in 5 seconds. When light, she entirely freed herself of water in 55 seconds. When running for the beach through heavy rollers, she showed great buoyancy and stability, without shipping water. She could carry 30 persons beside her crew, or 42 in all. The present boat in use has been developed from this one."

### Specifications of the Beebe-McLellan Self-Bailing Surf-Boat.

*Dimensions.*—Length over all, 25 feet 4 inches; length between rabbets at sheer-line, 25 feet; greatest breadth outside of planks, 7 feet; depth amidships above keel, 2 feet 5 inches; sheer of gunwale, 2 feet 1 inch.

*Keel or Bottom Piece.*—The keel is to be of white oak, 2 inches thick, 9¾ inches wide amidships, and rabbeted ⅛ inch in width for planks. The ends of the keel are to be steamed and bent up to shape.

*Stem and Stern Posts.*—They are to be of white oak, sided 2 inches, molded 4 inches at gunwale, and 5 inches at scarf of keel, overlapping the keel 8 inches, each lap to be fastened by two galvanized ½-inch iron bolts driven and riveted over burrs. These stems are to be cut out of timber with natural crook to suit the shape.

*Frames.*—The frames are to be bent out of white oak, siding 1 inch and molding 1⅛ inches, then cut to fit to the planking. The floor-timbers running across the keel are to be at least 4 feet 9 inches long amidships, and to be formed of knees at ends of boat; they are to be placed 12¾ inches from center to center amidships and closer at the ends, as per plan. Futtocks are to be placed alongside of each floor-timber, also between each of the floor-timbers amidships. Towards either end they are to be spaced, as shown on plan.

*Outside Planks.*—The outside planks are to be ten in number on each side of the boat, made of ½-inch thick white cedar, with ⅞-inch laps, and fastened with four-penny copper nails riveted over burrs, one through each frame, one between amidships frames, and two where the distance between futtocks increases. The hood ends are to be fastened with galvanized iron nails; the bevel-scarfs are to lap

2 inches, covered on the inside by 1½ by ⅝ inch white oak strips with six rivets passing through both, secured over burrs. At the bottom of each plank are battens of ½ by ⅞-inch white oak extending to within 4 feet from the ends of the boat; the one under the top-strake is to be ⅞ inch square, rounded on the outside and extending the whole length of the boat. An outside molding batten at height of sheer is to be of white oak, 2 inches deep, ⅞ inch thick, and rounded on outside; the fastenings to pass through the frames and inner gunwale.

*Gunwales and Breast-Hooks.*—Inner gunwales to be of white oak, 2 by ⅝ inch, fastened at ends into white oak breast-hooks made of knees with 5-inch throat and 14-inch arms. The breast-hooks are to be riveted through the stems.

*Thwarts.*—The thwarts, four in number, 7½ inches below the top of gunwale, are to be of 8 by 1¼ inch spruce with two white oak knees on each end on top, siding 1 inch, and with arms on thwart 13½ inches long; each thwart to have a ⅞-inch support underneath with cleats under thwarts and steps on deck. Other supports to be placed in the hold underneath upper supports.

*Seats.*—Seats on ends to be of ⅝-inch white cedar, supported by 1 by 2-inch cedar carlings; part of the forward seat to be removable; the tops or covering boards of the side air-tanks are continuations of the after-seat. All seats to be supported by ⅝-inch cedar planks. All as shown on plan.

*Deck.*—The deck is to be of ⅝-inch white cedar, about 5 inches wide, resting on cedar carlings 2 by 1 inch, which are let into risers of 2 by ⅝-inch cedar, all as shown on plan. The deck-planks are to be fastened by five-penny galvanized-iron nails set in and beeswaxed.

*Air-Tanks.*—The side-boards of the air-tanks are to be of ⅝-inch cedar, to reach from their covering-boards to the carlings of the deck, to which they are to be fastened. They are also to be nailed to the deck-planks in the spaces between the carlings, and bracing-strips of ⅝-inch cedar are to be fastened on top of each carling between the side-boards and the outside planking.

*Delivery-Tubes.*—The frames of the delivery-tubes are to be made of ⅞-inch white pine, jogged over frames, fastened to them and the outside planking, and provided on each side above the deck with 2½ by 4½-inch openings. Inside of these openings are to be valves of rubber packing fastened to the inside of tubes on top by two brass

screws passing through a protecting strip; on the bottom they have three to four ounces of lead clinched on by copper tacks. Around the opening on the inside of the tubes are strips of cedar running from nothing at the top to ¼-inch at bottom, put on with galvanized brads, and with paint between them and the boxes. Tops of boxes to be of ⅛-inch cedar. The tubes to taper in both directions, as shown on plan.

*Bitts and Cleats.*—Bitts and cleats of white oak forward and aft, as per plan.

*Ring-Bolts.*—Ring-bolts through both stems of ⅜-inch galvanized iron, rings of 3-inch opening—all well clinched over rings on inside of stems.

*Row-Lock Beds.*—The beds are to be of white oak, 15 inches long and 1 inch thick, fitted for tholepins and fastened to outer planks and inside gunwale by galvanized iron screws; they are to be partly let into the inner gunwale. The center of rowlocks to be about 10 inches abaft the after edge of thwarts, and the centers of tholepins to be 5½ inches apart.

*Steering Oarlock.*—The steering oarlock is to be of composition, shaped as marked in plan, and passing through an opening in a galvanized iron band. This band to have arms 13 inches long, 1½ inches deep, and ⅜ inch thick, and to be fitted around stern-post and to outer molding-batten, and to be fastened by ¼-inch iron rivets, clinched over burrs on inside of breast-hook.

*Man-Hole.*—The man-hole is to be 17½ inches in diameter, and have a flanged brass ring fitted around it; the ring to be 1 inch deep and the flange, 1 inch wide; the flange to be on top of the deck, and secured to it by brass screws.

The cover is to be of cedar in one or two thicknesses, the top being ½ inch above the deck and extending ½ inch beyond the man-hole, so as to form a shoulder; a brass flanged ring is also to be fitted to the cover, the ring to be ⅝ inch deep and the flange, ⅝ inch wide; the flange to be underneath the cover and secured to it by brass screws.

The two rings are to screw into each other, and to be with their flanges ¼ inch thick.

On top of the cover there are to be screwed two oak battens slightly out of parallel, and to the space between them is to be fitted a tapered wrench of oak.

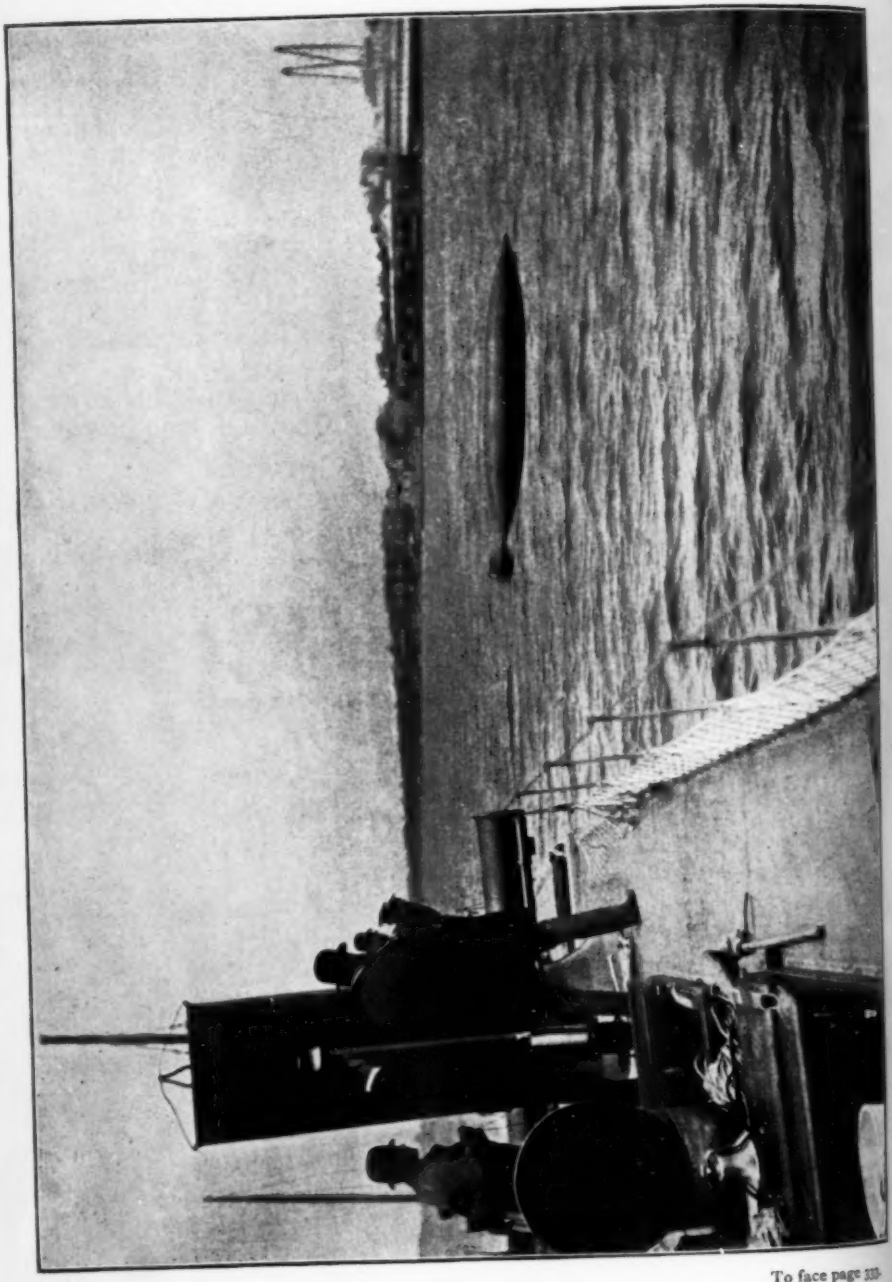
*Pump.*—There is to be in the hold of the boat a brass pump of 3-inch inside diameter, with rubber boxes and a cover screwed into the top, as shown on plan.

*Ventilators.*—In each of the side air-tanks is to be a brass ventilator of 1½ inches opening.

*Calking.*—The deck and air-tanks are to be carefully calked with cotton and white-leaded.

*Paint.*—The outside of the boat is to be painted with two coats of good oil paint, green to water-line and white from there to molding-batten. The inside of boat is to be either painted or receive two coats of spar-varnish, as the superintendent may direct.

*Materials.*—All the materials to be of first quality; all the wood-work to be of perfectly seasoned stuff, clear and free from sap and bad or large knots, and the workmanship and finish to be first-class in every respect, all subject to the approval of the superintending officer.



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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

JUNE 3, 1890.

REAR-ADMIRAL L. A. KIMBERLY, U. S. N., in the Chair.

# THE HOWELL AUTOMOBILE TORPEDO.

BY E. W. VERY, *of the Hotchkiss Ordnance Company.*

## PART I.

### THE INTRINSIC VALUE OF THE TORPEDO AS A WEAPON OF OFFENSE.

In popular discussions of the value of the torpedo as a weapon of offense, it very frequently occurs that the objective feature of the weapon is lost sight of, or becomes confused with the condition of its development, so that, because with any particular type the results hitherto obtained have been but moderately successful, doubt is expressed as to the intrinsic value of the weapon, and it is even a commonly expressed opinion that sooner or later some form of ordnance capable of discharging large quantities of a high explosive will entirely replace all torpedoes except perhaps fixed mines for the defense of channels.

In naval warfare the torpedo is as distinct a class of weapon and is as independent of all ordnance development as is the "arme blanche" (such as the bayonet, sword, etc.) from the fire-arm in military warfare. The invention of fire-arms created no new objective feature of warfare, but simply provided a means of meeting a necessity that had always existed. During the first period of the introduction of fire-arms as infantry weapons, the line of battle consisted of ranks of arquebus men and ranks of pikemen. The distinct objective features of the two weapons were confided to different corps. The invention of the bayonet enabled one corps to fulfill both features, but neither this consolidation nor any improvement, from the matchlock to the magazine rifle, or from the pike to the sword-bayonet, has in the least degree affected the objective features themselves, nor have

improvements in one weapon lessened the necessity for the possession of the other.

Precisely the same conditions exist in naval warfare between ordnance and torpedoes. The former class of weapons is and can only be devoted to the attack of the above-water portions of a vessel, whilst the latter is as exclusively devoted to the under-water body. As ordnance has developed in power, the engines, boilers, steering-gear, magazines and other vital elements of fighting power have been driven for safety to the under-water body, for it is there that the defense is the strongest and the offense the weakest. To leave the attack of the under-water body out of consideration simply because hitherto the development of the torpedo has been but extremely limited, is to omit a fundamental principle of offensive tactics. It has been only one hundred years since Bushnell invented the torpedo. He created no new objective feature any more than did the inventor of the arquebus. It required Cushing's attack on the Albemarle to convince the world that the feature not only existed, but was of prime importance, and from that day the development of the weapon that shall most effectively fulfill that feature has been unceasing, and in the very nature of naval warfare will continue to be.

The torpedo, as a naval weapon of offense, is a permanent weapon, and no ordnance development, no matter what be its nature, can in the slightest degree affect its existence.

### CLASSIFICATION OF PURELY NAVAL TORPEDOES.

As in the general discussion of the value of torpedoes, the absolute necessity for the existence of the weapon loses appreciation from confusing it with considerations of the state of development, so in the discussion of development, a failure to properly distinguish the natural classification leads to confusion in the attempt to compare different types.

It would be manifestly absurd to attempt to compare directly and generally a magazine rifle with a field gun, or a field gun with a mortar. Quite as distinct a classification exists amongst torpedoes. Fixed mines have a certain special field of action within which they are undoubtedly superior to torpedoes designed for other fields. Torpedoes that are propelled and guided from a fixed point, with which they are in some manner constantly connected, have also their distinct field. Torpedoes that may be classed under the head of

purely naval torpedoes occupy a field of their own, for they are required to be effective in waters of an indefinite depth and under all conditions of movement of the point of discharge.

Considering only this general classification of the naval torpedo, it will be found that, as represented by development, the different types come naturally under one of the three following subdivisions:

1st. The fixed torpedo, carried and used by a vessel at a fixed and very limited distance from it, such as the Spar and the Towing torpedoes.

2d. The semi-automobile torpedo, which upon discharge is independent of the vessel, but which for range is dependent upon the force of projection, and which lacks a complete development of directive force, such as the projectile from the submarine gun.

3d. The automobile torpedo, which, independently of the vessel and irrespective of the means of discharge, maintains its speed by self-contained motive power, and its depth and direction by self-contained directive power.

These subdivisions are developments the one from the other in the order above given, and that the higher development has not rendered the lower one obsolete is due entirely to incompleteness of development. The "bag of powder on the end of the pole" so ably handled by Cushing is clearly but of a most limited efficiency, since it can scarcely be used beyond a distance of fifty feet; yet it is not entirely obsolete, because certain features which it possesses within that distance are as yet not as certainly assured in the higher developments. The projectile ejected from the submarine gun possesses elements of great simplicity, but it needs but a cursory examination to show that it is an inferior development to the automobile torpedo, for it depends upon the force of ejection entirely for its speed and range; but precisely the same force may be applied in precisely the same way to the automobile torpedo, producing exactly the same result. The automobile torpedo, however, possesses, *in addition* and entirely independent of this force of ejection, an *inherent* propulsive and directive force, which is so much clear gain over the submarine projectile, and any attempt whatever to increase range and accuracy of the latter can only be obtained through an approach to the automobile condition. Therefore the automobile torpedo is the highest (not necessarily the best perfected) development of the naval torpedo.

## THE PRESENT STATUS OF THE AUTOMOBILE TORPEDO.

The velocity, range and accuracy of all automobile torpedoes thus far developed are almost incomparably inferior to those of ordnance projectiles, and on this account it is frequently argued that under present fighting conditions it would be very exceptional that the condition would occur where, in action, the torpedo could be used with a reasonable chance of success. This argument is upheld by the evidence (undoubtedly true) that in the wars which have occurred since 1875, at which date the automobile torpedo became a practicable weapon, the results obtained have but a negative value. That is, whilst they may have shown possibilities of future development, there has been no instance of positive success.

That this argument is erroneous is readily susceptible of proof.

1st. We have the undoubted fact that, in spite of all failures and in the face of immense expenditures, every navy in the world not only has made strenuous efforts to develop the automobile torpedo, but the demand for this weapon and the efforts to improve it have steadily increased since the commencement, now nearly twenty years ago. Precisely as with the change from the smooth-bore to the rifled gun, from the muzzle to the breech-loader, from the cast-iron to the built-up steel gun, there is more than a simple novelty involved. The development of the automobile torpedo must go forward, for it is universally and truthfully regarded as an accessory of armament absolutely necessary. It is only necessary to go back thirty years to find the same argument used against iron-clads, or twenty-five years to find it against breech-loading ordnance, or ten years to find it against magazine rifles. The automobile torpedo is as irresistible a development as either of these.

2d. It is conceded by naval tacticians that the general fighting range in naval action will be within seven hundred yards. The automobile torpedo has, within the past five years, been so developed as to become more than a fairly efficient weapon at that range.

3d. It is the automobile torpedo, and that alone, that has forced into existence the worst hamper to effective naval fighting yet known. The net. There is, perhaps, no argument so common against the automobile torpedo as that it is useless because the net will keep it clear of the ship, and yet none is more fallacious. With precisely the same truth might it be said that guns were useless, because armor would keep out projectiles. All naval sea-going vessels now

carry nets as a part of their defensive equipment. No commander would use his net in action, knowing that his opponent did not carry automobile torpedoes, and every commander will use his net, knowing that the enemy carries them. A commander without an automobile torpedo, no matter how crude, must hamper himself with a net, whilst he leaves his opponent not only unencumbered, but with a weapon capable on a chance of deciding an action at a single shot.

The conclusion is inevitable. No weapon can replace the torpedo or affect its existence and development, because to the torpedo alone belongs the attack of the under-water body. Of the naval torpedoes as above defined, the automobile is the highest class of development. Types may be more or less efficient, and the sole reason for the Whitehead torpedo having been universally accepted with all its faults is because it has hitherto been the only practicable type. Valid arguments may be made against the Whitehead, or any other type of automobile torpedo. But none whatever can be made against the automobile torpedo "sui generis."

### TYPE DIFFERENCES BETWEEN THE WHITEHEAD AND THE HOWELL AUTOMOBILE TORPEDOES.

The first successful type of automobile torpedo developed was the Whitehead, whose only competitor heretofore has been the Schwartzkopf, which really possesses no type difference. A distinct rival in type to the Whitehead is the Howell, and in following the discussion of the merits of type differences between these rivals, it is necessary to keep constantly in mind the fundamental definition of an automobile torpedo, which is: one that, independently of the vessel and irrespective of the means of discharge, maintains its speed by self-contained motive power, and its depth and direction by self-contained directive power.

In both the Whitehead and the Howell types the speed is maintained by the action of screw propellers. In the Whitehead the screws are actuated by an engine, whose motive power is compressed air, which is carried in a tank in the torpedo, feeding the air to the engine as a boiler feeds steam to an ordinary engine. In the Howell the screws are actuated by a heavy fly-wheel, without the interposition of an engine, the energy of the fly-wheel being the motive force. In this difference of application of motive power appears the first marked contrast of type.

The Howell contains no engine, and thus gains a very important

advantage in simplicity and economy over the Whitehead. On the other hand, the motive force of the Whitehead may be kept stored in the torpedo for a certain length of time, so that, in so far as this element is concerned, when it is inserted into its launching tube, it is always ready for instantaneous discharge. The Howell, however, can only have its motive force applied or stored in it after it is inserted in its tube, so that, in so far as fighting conditions are concerned, only the first torpedo inserted can be kept in readiness for instantaneous discharge. This drawback to discharge, however, is less serious than may at first appear, for in action the first torpedo can be discharged at will at full speed. As at present developed, the launching tube may be reloaded, the fly-wheel be spun to full speed, and the torpedo be discharged as quickly as a twelve-inch gun can be reloaded and fired. At half speed of torpedo the rapidity of fire can be nearly doubled. Finally, rapidity of fire is in a very great measure due to the power available for spinning the wheel, and it is beyond all question that this power may be readily and securely applied in much less than half the time required under present conditions, so that the case will be very exceptional, indeed, where in action a torpedo will not be ready at the instant that it is wanted.

In both types the depth of immersion is maintained by a horizontal rudder, actuated by a hydrostatic piston and a pendulum. The arrangement of the combination in the two types is quite dissimilar, but there is no absolute type difference. The discussion of this element belongs, therefore, to a detailed description of the mechanism itself.

In the Whitehead, constancy of direction is maintained by means of vertical rudders, which are adjusted to suit the conditions known or estimated to exist throughout the trajectory at the moment of firing. These rudders must be set just previous to discharge. The Howell has no directive rudders or mechanism whatever, but maintains a rigid direction through the gyroscopic force of its fly-wheel.

In this respect not only does the Howell gain in simplicity in having no vertical rudders or attachments, but, what is of far greater importance, it requires no adjustment for direction before firing. In a very great measure what is gained by the Whitehead in having its motive force stored in it, so that it is ready for discharge when put into the tube, is counterbalanced by the condition that any change in speed of ship, or keel angle of fire or heel of ship after insertion of the torpedo, demands a readjustment of the vertical rudders.

With this drawback to the Whitehead it is almost absolutely necessary, for full efficiency in battle, that the keel angle of fire of any single launching tube should be permanent, whilst with the Howell, since no adjustment is necessary, the launching tube may be pivoted and brought to bear on the enemy at will, with security as to accuracy in flight.

It will be readily understood that an automobile torpedo, from its general spindle shape and complete submersion, is extremely sensitive to the action of disturbing forces, either interior or exterior. The weight of compressed air carried by the Whitehead is with the smallest torpedo made more than twenty-five lbs., and during flight this weight is being constantly decreased. It is therefore quite impossible to maintain the relative positions of the center of gravity and center of buoyancy so that, no matter how exact may be the original adjustment, it will not hold throughout flight, and any variation leads to error either in constancy of depth or direction. In the Howell, the amount and distribution of weight is constant, so that this cause of error is entirely avoided.

In the Howell, the gyroscopic force gives to the torpedo great rigidity against rolling on its longitudinal axis. The Whitehead is most sensitive of all to such a disturbance, and it will be readily seen that the action of rolling directly affects the functions of the rudders, giving to the horizontal rudder a horizontal steering power. It is found necessary with the Whitehead to carry the propellers the one behind the other, mounted on middle line shafts, and it is found that as the speed of these screws exceeds or falls short of a certain normal, either the rear or the front screw tends to rotate the torpedo on its longitudinal axis. For this reason it is necessary to so regulate the supply of condensed air to the engines that the speed of the screws (and consequently the speed of the torpedo) shall be nearly constant throughout its run. This leads to a very appreciable waste of power. On the other hand, with the Howell, the twin screws are mounted on parallel shafts in the normal manner, and no regard need be paid to any difference in rotating power that one screw may have over the other; they balance themselves, and, even if from any cause they did not, the torpedo is held rigid against rotation by the gyroscopic force of the fly-wheel. This being the case, the full power of the fly-wheel is applied to driving the torpedo throughout the run, and as a consequence the speed developed over the first parts of the run may be higher than with corresponding Whiteheads, whilst at

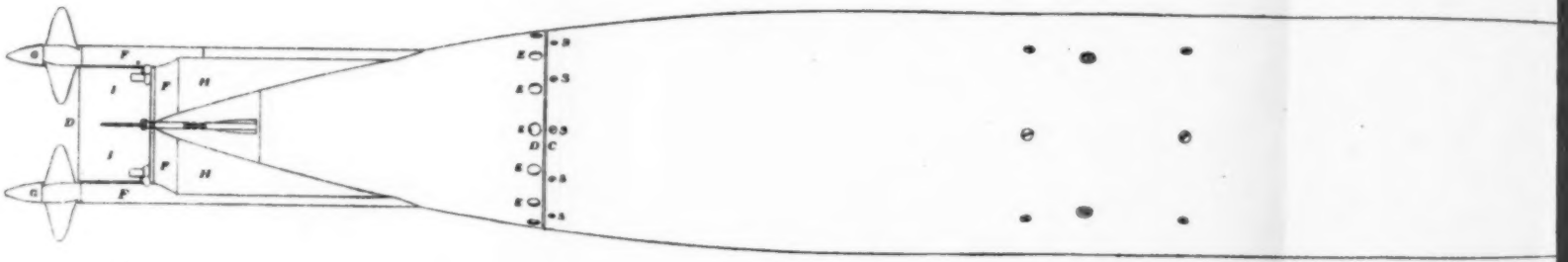
an extreme range, accuracy in direction is maintained at a low speed, which is impossible with the Whitehead.

It is considered necessary with any automobile torpedo that in case it should fail in action to strike the enemy, it should be capable of sinking automatically, to avoid the chance of being overrun and exploded by a friend. In a general action also, it is of great importance that a torpedo once discharged should not sheer wide enough from its direction of projection to endanger striking a friend. With the Whitehead, assuming that on discharge its buoyancy is negative, so that it would sink when uncontrolled by its horizontal rudder (which would be the case at the end of its run), it loses so much weight of compressed air as to give it a positive buoyancy, and therefore a special mechanism has to be introduced to allow water to enter the body of the torpedo at the end of its run and sink it. With the Howell this is not necessary, as its weights do not change, and, being started with negative buoyancy, it will sink of its own accord at the end of its run.

It may seem from a cursory examination that with the Whitehead such a disposition could be made that the loss of weight of air could be compensated by admitting water. This, however, is impossible unless the water could replace the air *in position*. Any attempt to do it results in aggravating the variation of the center of gravity with regard to the center of buoyancy, and with water ballast thus taken in, if the torpedo tended to roll in either direction, the water would aggravate the tendency.

As has been explained, when the speed of the screws falls an appreciable amount below the normal, a tendency to heel the Whitehead torpedo is created, and the heeling in turn sheers it broadly out of its course. Therefore, in order to avoid the danger of an erratic course, it is necessary to introduce a mechanism to cut off the air and stop the torpedo when it has run to the limit of range permissible under its constant speed. This difficulty also is entirely avoided with the Howell.

Speed is undoubtedly a most important element of efficiency in automobile torpedoes. With regard to the comparative speeds of the two types, although the Whitehead has records of speeds much higher than any attained by the Howell, it must be borne in mind that with all automobile torpedoes, irrespective of type, speed is in a great measure a function of displacement. The largest Howell torpedo yet built is smaller than the smallest Whitehead used.



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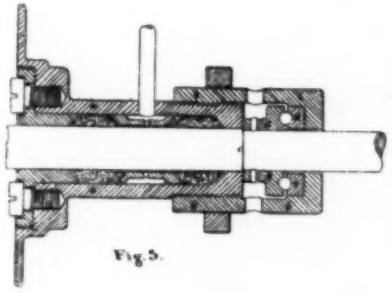

Fig. 3.

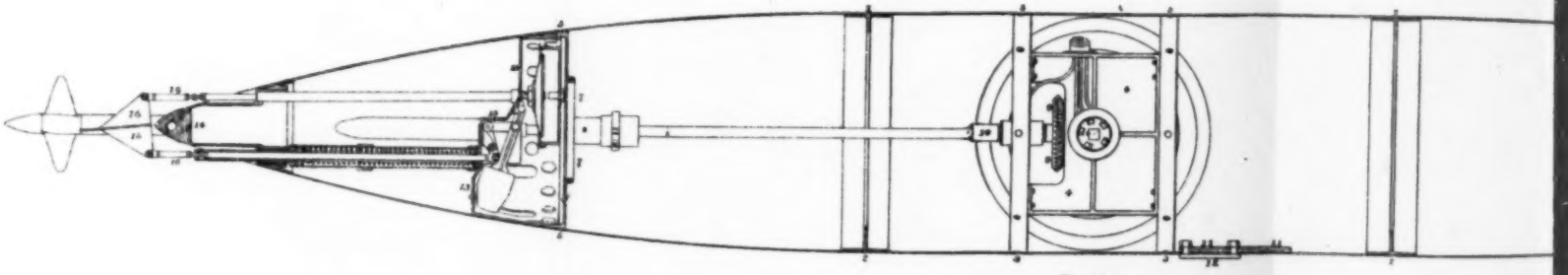

Fig. 2.

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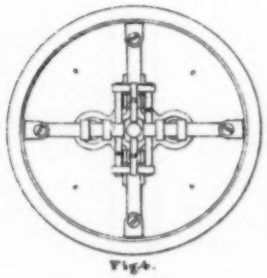
Fig. 1.



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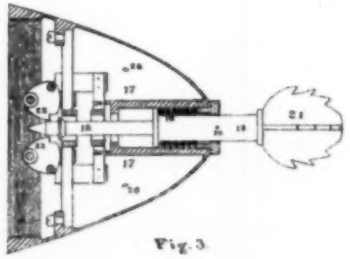

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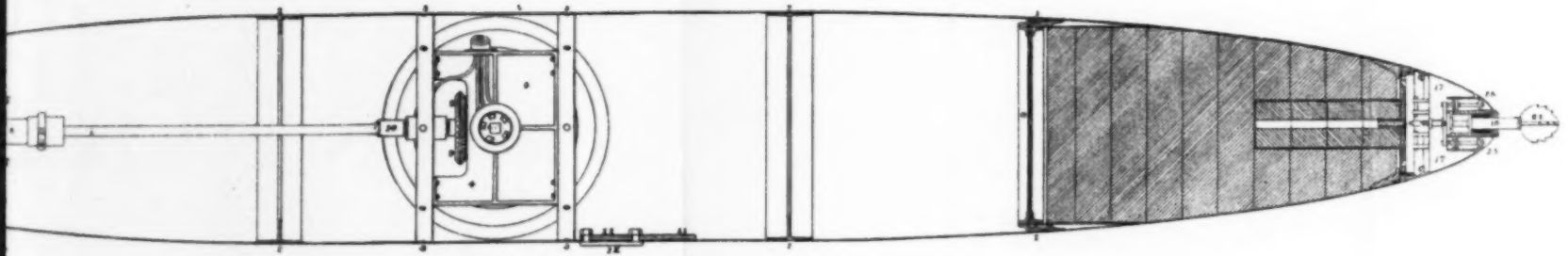

Fig. 2.

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There is no valid reason why, for equality of displacement, the speed of the Howell should not be fully as great as that of the Whitehead, and also capable of as much future development.

In the compartment division, section-fastening, bulk-heading, bracing, arrangement of charge and position of details, there is scarcely a single point of resemblance between the Whitehead and the Howell. These details, however, can scarcely be classed as typical, nor can they be compared and their merits be discussed except in the course of detailed description.

## PART II.

### GENERAL DESCRIPTION OF THE HOWELL AUTOMOBILE TORPEDO.

Plate I.

The general profile of the Howell torpedo is that of a spindle of revolution, the after-body being a true spindle, the middle body a cylinder, and the fore-body an approach to an ogive. There are four distinct and detachable sections: the nose, *A. A.*, which carries the firing-pin and its mechanism; the head, *B. B.*, which carries the explosive charge and detonator; the main section, *C. C.*, which carries the fly-wheel and screw gears; the stern section, *D. D.*, which carries the diving mechanism.

The principal weights and dimensions of the General Service torpedo are as follows:

| | |
|---|---|
| Diameter of midship section, | 14.2 inches. |
| Length of body of torpedo, | 116.0 " |
| Length from tip to tip, | 128.0 " |
| Length of nose section, | 6.0 " |
| Length of head section, | 20.0 " |
| Length of main section, | 67.0 " |
| Length of stern section, | 32.5 " |
| Weight of fly-wheel, | 131.4 lbs. |
| Weight of explosive charge, | 100.0 " |
| Total launching weight, | 475.0 " |
| Reserve buoyancy with full charge, | 3.0 " |
| Reserve buoyancy with dummy head, | 13.0 " |

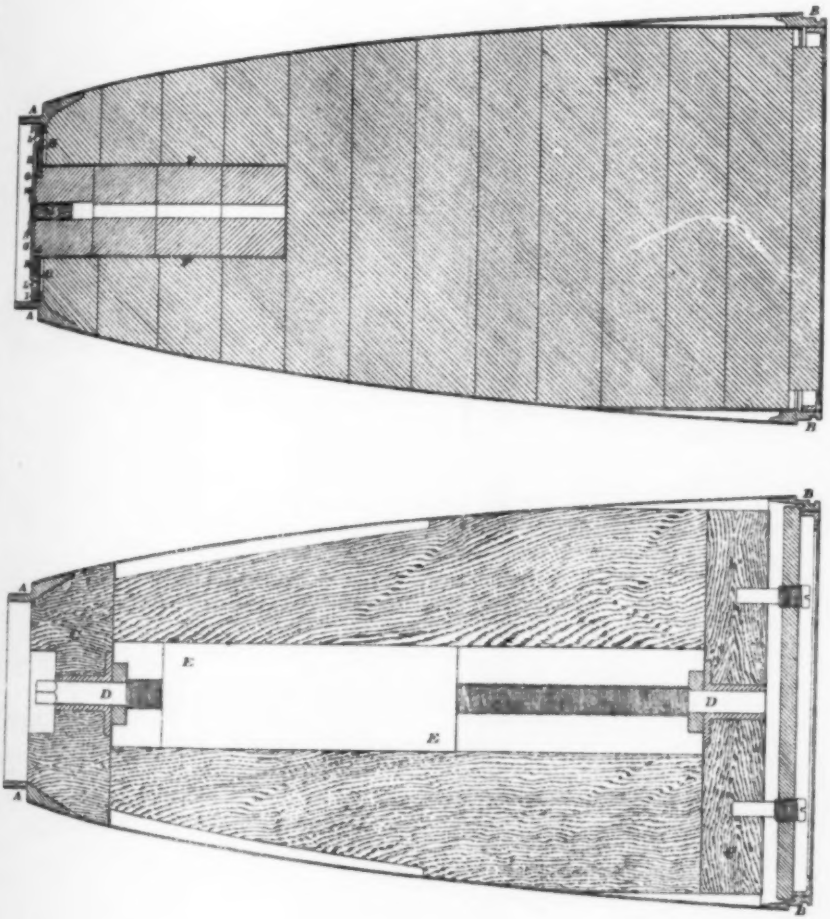
### THE NOSE.

Plate I.—Figs. 2, 3 and 4.

In order to guard as completely as possible against a premature discharge of the torpedo in handling, the percussion firing-pin is so arranged as to be completely removable, and also to be quickly attached at the last moment before inserting the torpedo in the launching tube. If the pin alone were made removable, as it is but a small accessory, it might be overlooked in the heat of action. Also, if any preliminary manipulation of the mechanism were necessary to get it into proper condition for firing, an error or omission might be made. The entire firing-pin mechanism is therefore permanently fixed in a single hollow bronze casting 17, 17, which is attached to a projecting lip at the front end of the head by a simple bayonet joint, so that a few seconds only are necessary to attach and detach it.

The United States naval specifications for firing-pins of torpedoes demand more functions and greater security than have heretofore been required. When attached to the torpedo it must be locked safe from discharge whilst handling the torpedo and previous to launching; it must arm itself for firing automatically after launching; it must act if striking an opposing body at an angle of fifteen degrees from its axis; it must automatically lock itself securely at the end of the run of the torpedo. These functions are performed by the following arrangement of mechanism: a stout steel pin, 18, travels in guides formed in the nose casting, and is actuated by a strong spiral spring, 19. It is held back in the armed position by a soft metal pin, 20, which seats in a slot cut through the pin, and bears against the outside of the nose. The outer end of the firing-pin is provided with fan-shaped corrugated horns, 21, which receive the impact blow, and are so shaped and arranged as to prevent glancing or sliding along the object struck when the impact is sharply angular. The force of the blow is intended to shear the soft metal stop-pin, and thus permit the firing-pin to be driven violently down on the detonator by the spring.

Two small cams, 22, 22, are so pivoted and maintained by the small flat springs 23, 23, that normally they rest against the body of the firing-pin just under a shoulder, so that if from any accident the pin after cocking should be so struck as to shear the soft metal stop-pin, it could not drive down and explode the detonator. Just in front of the cams is a cross-head, 24, having projections which rest

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on the cams so that as the cross-head is pushed to the rear the cams are turned out clear of the shoulder, leaving the firing-pin clear. The cross-head is in turn in connection with two small pistons, 25, 25, which are held forward by the cam springs. The front ends of these pistons come out flush with the outer surface of the nose and are entirely open. When, after launching, the torpedo strikes and rushes through the water, the direct pressure on these pistons forces them back against their springs, in turn pressing on the cams and turning them back clear of the firing-pin, which is then completely armed for action. When the speed of the torpedo becomes so reduced as to permit the piston springs to overcome the pressure of water on the pistons, they come forward, the cams turn in under the shoulder, and the firing-pin is again locked. The condition of the firing-pin is at all times plainly visible. The soft metal stop-pin is on the outside, where its condition is always visible. The length of the firing-pin projecting beyond the nose shows whether it is cocked or not. The piston heads being plainly visible, show at all times whether the cams lock the pin or not. Except the fingers be deliberately used to push the pistons back, the firing-pin cannot be unlocked in handling the torpedo. Finally, all parts are secured in the single nose, and in such a way that absolutely no preliminary work is required. At the last moment the nose-piece is secured to the head by a simple twist of the bayonet joint.

It is to be remarked that when the nose is off the head the front of interior of the head is laid bare, so that the detonator itself may be kept out of the torpedo until the last moment. Small holes, 26, 26, inclining strongly backward are pierced through the nose and are left open. These holes leak water into the hollow nose-chamber when the torpedo is stationary or at low speed, which overcomes the reserve buoyancy of the torpedo, sinking it, and finally attacking and drowning the dry gun-cotton detonator, so that if the torpedo fails to make a hit, it locks its firing-pin, sinks and drowns its detonator, being thus rendered completely innocuous.

### THE HEAD.

### Plate II.

In order that the explosive charge of the torpedo may be readily attached and detached, be stowed compactly and safely in a magazine, and at the same time that the torpedo may be used with perfect

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In order that the explosive charge of the torpedo may be readily attached and detached, be stowed compactly and safely in a magazine, and at the same time that the torpedo may be used with perfect

safety in exercise, it is provided with two distinct heads that correspond exactly in profile; the nose being interchangeable with either head, so that the firing-pin may be used both in exercise and in battle, and the connection between the head and the main section being precisely the same with both. These heads are distinguished as the dummy head and the fighting head.

The shells of both heads are made of a single sheet of brass brazed and spun to shape and braced by bronze rings, *A. A. B. B.*, at the front and rear ends. Each of these rings is prolonged slightly beyond the end of the shell to form bayonet joint locks, the front one for holding the Nose, the rear one for securing to the Main Section.

The dummy head carries a heavy wooden block, *C. C.*, quite filling the interior space. This block has a square hole cut through its axis and carrying an iron threaded bar *D. D.* Upon this bar is a square lead block *E. E.* The inner end of the bar being squared, it is readily seen that by turning it the block is traversed back and forth. By this means the torpedo is balanced longitudinally. It is necessary here to explain that when the torpedo is launched, no matter whether it has buoyancy or not, its diving mechanism will keep it at its proper depth. It is desirable that the greatest weight of explosive possible should be carried, and also, as has been heretofore explained, that it should sink at the end of its run if it fails to make a hit. Therefore, with the fighting head the buoyancy is practically nil, and the torpedo is permanently balanced in its entirety for this condition. For exercise, however, the torpedo must not be allowed to sink, as it would be lost. The dummy head, therefore, is lighter than the fighting head, so as to give about thirteen pounds buoyancy, and the lead block is introduced in order to give a long arm to a compact heavy weight in the section that is not water borne, so as to keep the center of gravity of the torpedo in the same position relatively to the center of buoyancy as that occupied with the fighting head. Otherwise there would be a difference of leverage between the two conditions that would alter the steering adjustments. A single shop adjustment of this block is sufficient, and it maintains its place unless moved by screwing the bar.

A complete bulkhead plate screws water-tight into the rear end of both heads.

In the fighting head, the main part is completely filled with wet gun-cotton, a small water-tight chamber, *F. F.*, formed of a single piece of drawn copper being reserved for the dry gun-cotton primer.

This chamber is removable, having a flange *G. G.* at its mouth, which seats on a diaphragm *H. H.* screwed across the mouth of the front casting by means of a ring *I. I.* screwing down on a rubber gasket. A cap *K. K.* covers the primer chamber, being held in place by spring catches *L. L.*, and forming also the seat for the detonator *M.*, which is held in place by the spring catches *N. N.*

By this arrangement the detonator may be removed, and, as the dry primer is contained in a thin tin case, it also is readily removable, leaving the head with only the wet gun-cotton charge, which itself is at all times hermetically sealed in proper shape for stowage in a magazine, the primer and the detonater also stowing separately in their own magazines.

Two small holes *O. O.* are drilled through the cap of the primer compartment, and are filled with a substance that is soluble after long contact with water. As above explained, the holes in the nose admit water at the end of a run. The water attacks the composition, filling the holes in the cover, and after a number of hours dissolves it out, and so drowns the dry gun-cotton primer.

### THE MAIN SECTION.

Plate I.

This section comprises the entire cylindrical body of the torpedo and portions of the curved part at either end. The shell consists of three sections of brass plate corresponding to the cylindrical and curved portions, brazed and spun to shape. The section is closed water-tight at both ends, and contains the fly-wheel with its frame, the propeller gears and forward sections of shafting, and the thrust bearings.

The shell is braced against deformation or crushing by six rib rings. A bulkhead ring, 1. 1., which is flanged, and in which are worked the sockets of a bayonet joint, by which the head is secured to the main section. The flange of this ring is threaded, and receives a complete water-tight bulkhead plate, 6. In all automobile torpedoes heretofore constructed, great difficulty has been encountered in making section joints water-tight to resist the great water pressure due to depth of immersion, and in order to secure this very important feature, it has been found necessary to make a junction so complicated as to make it not only a matter of difficulty to separate the sections, but, on account of the wear from frequent joining and

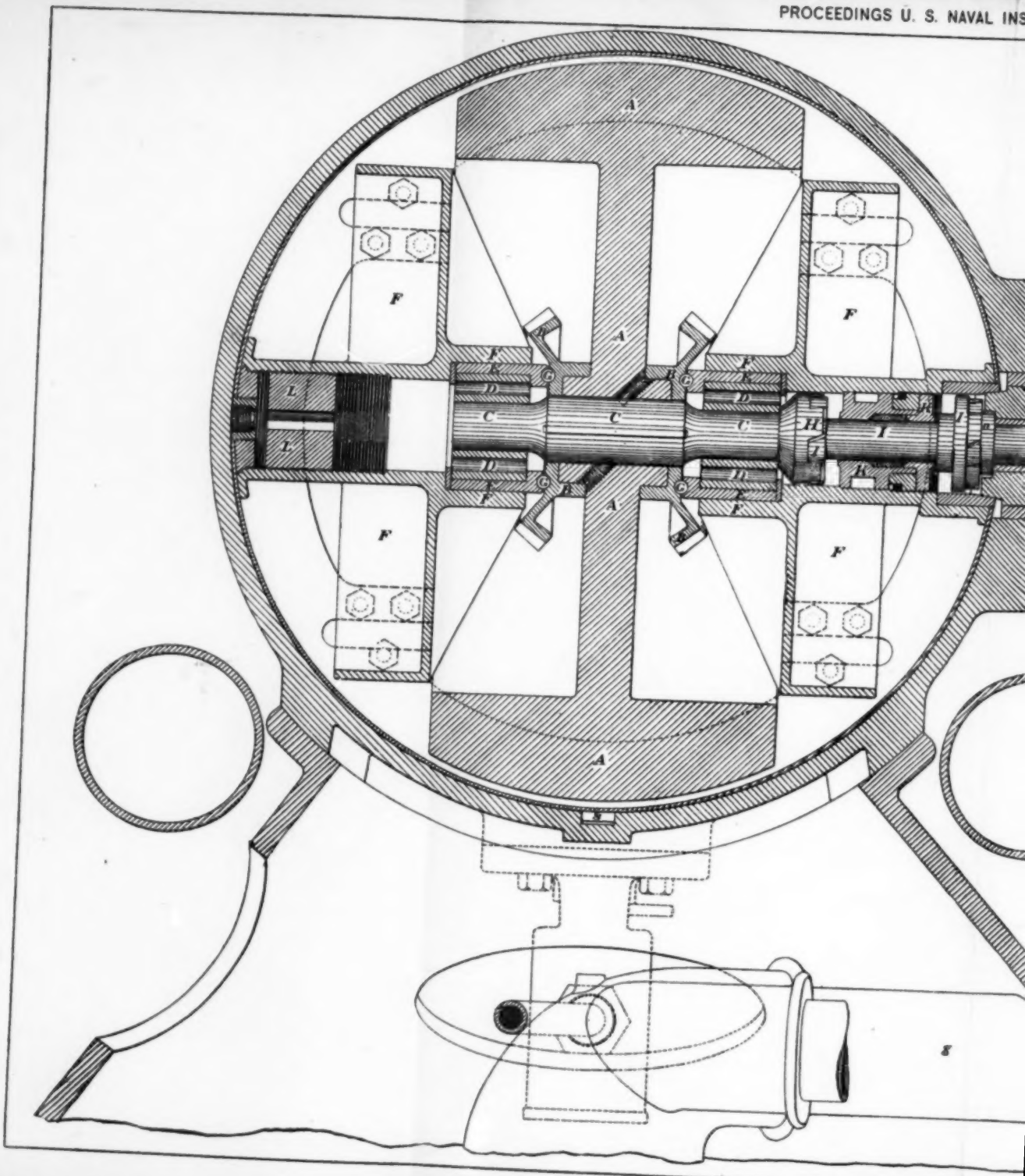
disjoining, the torpedo could not be taken apart and put together as desired. This feature has been overcome in the junction of the Howell section in a very simple manner, so that at this important joint the dummy and the fighting head may be quickly exchanged and without danger of compromising water-tightness. As has been described, there is a complete bulkhead plate at the rear of the head and another at the front of the main section. These plates naturally lie on either side of the joint, and when the sections are connected they are only about a hundredth of an inch apart. The space is so small that any leak that may occur through the joint does not admit water enough to be of any consequence, and so long as the joint is reasonably tight, the pressure due to immersion is relieved from any water that may lie between the bulkheads, so that it will not be forced past their joints. The torpedo has been sunk to a depth of forty feet without showing any signs whatever of leakage.

Two intermediate rings, 2. 2. 2. 2., are inserted under the brazed joints of the shell. These are simply plain, flanged, bronze rings. Two rings, 3. 3. 3. 3., support the midship section and at the same time form a part of the assemblage of the wheel frame, the other members of the frame being two plate castings, 4. 4. (shown in Section Plate III., *F. F. F. F.*), forming the bearings for the fly-wheel, which are bolted to the rings. Finally, a rear bulkhead ring, 5. 5., which, like the front one, holds a complete bulkhead, 7. 7., and also forms the seats for the thrust bearings, 8. It is impossible to connect the main and stern sections by a bayonet joint on account of the screw shafts, which prevent the twisting necessary to lock the joint. The strengthening ring of the stern section, therefore, has a lip which fits into an undercut in the flange of the main section ring and is held by screws, *S. S. S.* As this joint comes in the compartment containing the diving mechanism, which must be free to water access, it is not necessary that it should be water-tight.

### THE FLY-WHEEL AND ITS CONNECTIONS.

Plate III.

The fly-wheel, *A. A. A. A.*, is of gun steel, drop-forged and treated similarly to the tube and jacket forgings of guns. It has a heavy rim with a solid web connecting to the hub. Secured to the hub and symmetrically placed on each side of the web are two steel miter-wheels, *B. B. B. B.*, which gear into similar wheels, 9. 9., Plate I.,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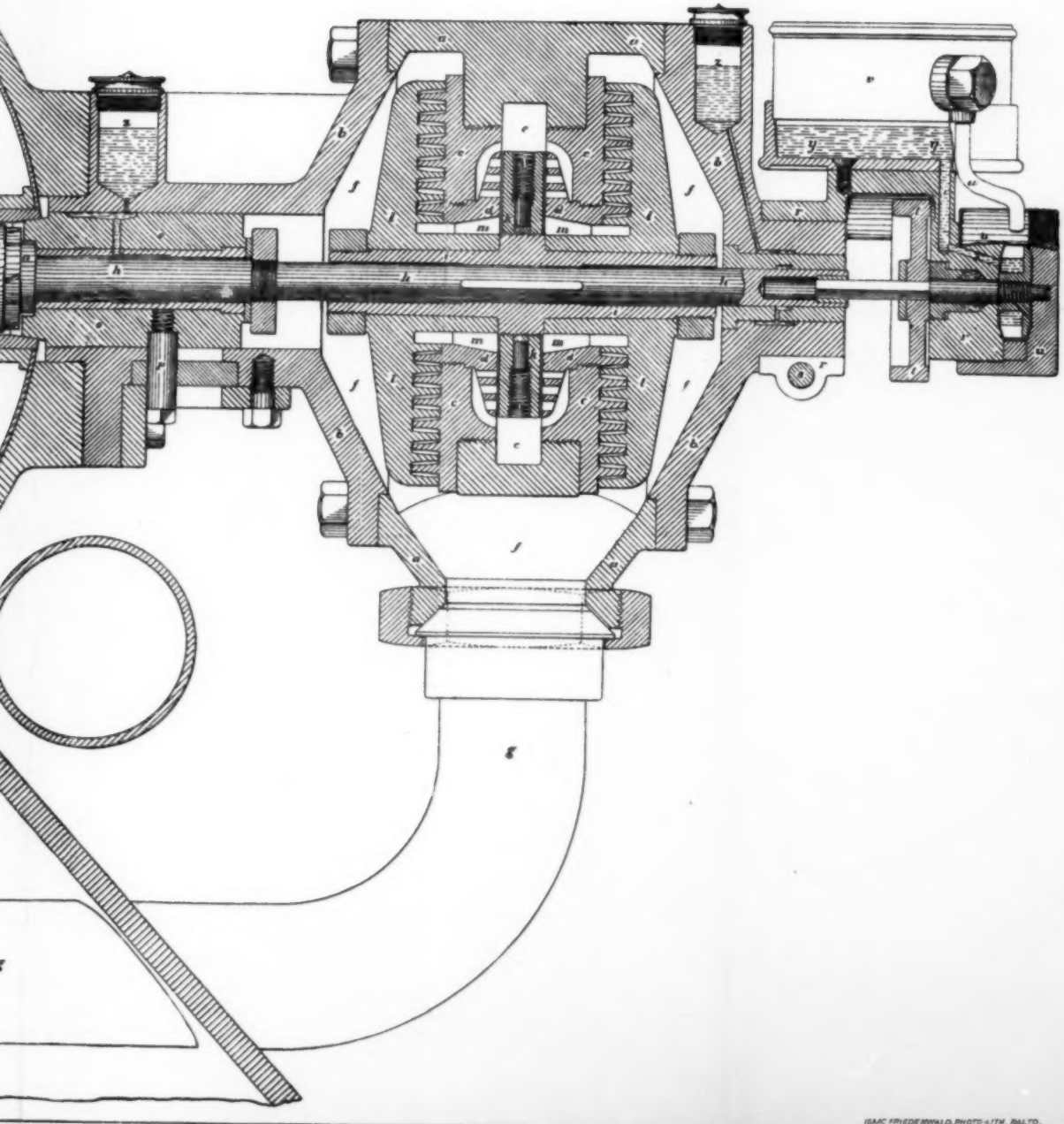

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secured to the inner ends of the screw shafts, the proportion of gearing being as five to four, so that each screw makes 800 revolutions to every 1000 of the fly-wheel. The axle of the fly-wheel, *C. C. C.*, is a single solid steel axle, permanently secured in its seat in the wheel, its bearing ends resting on hard steel rollers, *D. D. D. D.*, in hard steel bearings, *E. E. E. E.*, which themselves seat in sockets cast in one with the frame plates, *F. F. F. F.* The inner ends of the bearings, *E. E.*, and the bodies of the miter-wheels facing them are grooved and hold steel balls, *G. G. G. G.*, forming ball bearings to take the end thrust of the fly-wheel. Thus the wheel is provided with frictionless bearings, no matter what be the plane of the axle when rotating.

The connection between the fly-wheel and its motor, which forms part of the launching gear, is made through the starboard side of the torpedo by means of clutch couplings to the end of the axle. The right-hand end of the axle is squared, and carries pinned on it a steel end clutch, *H.* A loose clutch, *I. I.*, is held in a stuffing-box, *K. K.*, seated in a prolongation of the frame plate which bears against the shell of the torpedo, a through-hole being cut in the shell and the joint being closed water-tight. This loose clutch, *I. I.*, is so made in order to free the fly-wheel from the friction of the clutch in the stuffing-box. After spinning up the wheel, the moment that the motor is unclutched this loose clutch commences to hang back from its friction in the stuffing-box. This brings the rear sides of the clutch studs in bearing, and as they are cut with a steep slope, the clutch is instantaneously driven out free of the wheel.

In order to preserve the balance or symmetry of the torpedo, the left-hand frame plate is carried out to the shell in the same way as the right-hand one. The interior of this projection is threaded, and a lead disc, *L. L.*, is screwed in to counterbalance the clutch and stuffing-box on the right-hand side. By means of this lead disc alone the entire torpedo is balanced transversely, for a small hole is tapped through the shell, through which a key may be inserted and the disc may be screwed in or out to make the necessary adjustment. Once made, it remains of itself.

Plate I.

The screw shafts proper end at the bearing 10, being secured to the axles of the miter-wheels, 9. 9., by a mortise and tennon connection. This is done with a double object—first, to prevent any skew

tendency in the miter-wheel being transmitted to the shaft, and second, to enable the shafts to be entirely disconnected from the contents of wheel frame. In order to neutralize the skew tendency of the miter-wheels, their short axles are held in close bearings in front of and behind the wheels, these bearings forming a part of the wheel frame castings, so as to remain constantly true. The screw shafts are carried straight to the rear through the box 8, forming a part of the rear bulkhead ring, and within which are thrust bearings and a stuffing-box, made necessary by the proximity of the free water compartment. The thrust bearings being placed here have a double advantage. They relieve the miter-wheels of all thrust, and more room is allowed to make stout bearings than if they were placed farther aft.

A broad, stout plate, 11. 11., is soldered to the bottom center of the shell, to which, on the outside of the shell, is bolted a long stud, 12. (S. Plate IV.). The function of this stud is to center and guide the torpedo in the launching tube.

Plate I.—Fig. 5.

The composition of the thrust-bearing and stuffing-box is as follows: Long seats, *a. a.*, are cast in one with the rear bulkhead ring, over which screw caps, *b. b.* The shaft is slightly increased in diameter at the point *c.*, forming a seat for the steel bearing ring *d. d.*, which has a companion bearing ring, *e. e.*, seated against the sleeve. Steel balls lie between these rings, thus forming a ball bearing. A bronze spanner clasps each of the caps and prevents them from unscrewing, while at the same time it resists any tendency to flexure or spreading of the shafts.

A small bronze loose sleeve, *f. f.*, is slipped on the shaft and lies in the stuffing-box section. This sleeve is pierced with holes and its ends are packed. In this way the stuffing-box is formed, and at the same time provision is made for oiling the bearings, for the oil coming down on the sleeve passes through the holes and is absorbed and distributed by the packing.

### THE STERN SECTION.

Plate I.

The stern section is divided by a water-tight bulkhead, 13. 13. 13, into two compartments, the forward one containing the diving mechanism and being open to the free access of water through the

inlet holes, *E. E. E.*, pierced through the shell, whilst the rear compartment is closed water-tight and is empty, save the sleeves passing through it, within which are the screw shafts and tiller rods. The rear end of this section is closed by a casting called the tail-piece, 14, which forms in one the butt of the tail and the screw shaft tubes with their cross support *F. F. F. F.* The screw shafts are taken in bearings in the tubes *F.*, and the screw propellers, which are right and left-handed, are screwed to the ends of the shafts, being held fast by end nuts, *G. G.*, which are shaped off in long cones to give a fair run to the water passing the hubs. The triangular spaces, *H. H.*, between the tail body and the screw shaft tubes are covered with plates in order to give a fair flow of water to the rudder and screws. The small chambers thus formed give additional buoyancy also.

The rudder, *I. I.*, is a steel rectangular plate completely filling the space between the outer ends of the screw shaft tubes. In this position it is secure against damage in handling the torpedo and fouling in running. A stout web, 15. 15, stands at right angles to the plane of the rudder, forming a steering yoke, to the ends of which are pivoted the tiller rods, 16. 16, which in turn are directly connected with the diving mechanism.

### THE DIVING MECHANISM.

### Plate IV.

The bulkhead, *A. A. A.*, separates the rear and water-tight compartment from the diving compartment, both being in the stern section. It is a single casting so shaped as to reduce the water space to the least possible dimensions consistent with the working of the mechanism, and has a broad flange seating on the shell to form a stout stiffening member of this part. The bulkhead, *B. B. B.*, which is the rear bulkhead of the main section, forms with *A. A. A.* a complete water chamber. The tiller rods, *C. C. C. C.*, are pivoted to the rudder yoke, *D. D.*, and pass, inside of sleeves, through the water-tight compartment and bulkhead, their inner ends pivoting directly to their respective parts of the diving mechanism, the upper rod being attached to the hydrostatic piston, *E. E.*, and the lower one to the compound lever of the pendulum, *F. G. H.* These tiller rods are provided with screw junctions, *I. I.*, for taking up lost motion and regulating the angle of the rudder.

The forward compartment being in free connection with the exte-

rior water, the pressure due to depth of immersion is fully borne on the piston, *E. E.* This piston fits loosely in its cylinder, *K. K.*, which is secured to the bulkhead by the posts and nuts, *L. L.* The posts are made hollow and connect with the interior of the cylinder, so that there is free air connection between the space in the cylinder behind the piston and the whole air space in the rear compartment, so as to prevent any back pressure on the piston. A rubber disc covers the piston, and is held water-tight about its edges so as to prevent water getting into the cylinder and at the same time offer no opposition to the free movement of the piston.

Near the front end of the lower tiller rod a seat, *M. M.*, is fastened to it, against which abuts the forward end of a powerful spring whose rear end seats against a movable sleeve, *N. N.* This sleeve screws into the rigid main sleeve of the rod, and a key may be used on the end outside the torpedo to screw it in or out and so alter the tension of the spring which alters the depth of immersion.

Assume that the depth at which it is desired to run the torpedo is ten feet, and that at that depth the total pressure on the hydrostatic piston due to the head of water is one hundred pounds. The rudder being held amidships, let the spring be adjusted to a tension of one hundred pounds. Since the tillers are directly connected, the one to the piston and the other to the spring, it follows that if a pressure of one hundred pounds be brought on the piston, the tension of the spring will be balanced and the rudder will lie amidships. This will occur at the assumed depth of ten feet. If the immersion be less, there will be less pressure on the piston, and the spring will hold the rudder partially down and so steer the torpedo down to its proper depth, and *vice versa.* It should be noticed that the tension of the spring varies inversely as its length, whilst the pressure on the piston varies directly with the depth. Therefore the helm is not thrown hard up and hard down as the torpedo departs from her proper depth, but it is eased over the proper amount to bring her easily to her proper depth. The point at which the helm is thrown hard over depends upon the length and strength of the spring, and as by specification requirements the torpedo must run within two feet of her set depth, the hard-over point is made slightly greater.

As a matter of course the torpedo will always move in the direction of its longitudinal axis. Whilst therefore through the action of the hydrostatic piston the rudder will be brought to a neutral position at the proper depth, the torpedo must be horizontal at that

depth or it will continue to go down or up, according to the direction in which it points. The piston cannot correct the direction of the axis of the torpedo except secondarily. It is therefore necessary to introduce an element that shall counteract every tendency of the longitudinal axis to leave the horizontal, and this element is the pendulum.

A heavy pendulum, *H.*, is suspended so as to swing in the fore and aft-line of the torpedo. We may say, therefore, that whenever the axis of the torpedo dips down or up, the pendulum swings forward or aft. The bob of the pendulum, which is very heavy, is mounted on springs, *O. O.*, on its suspension rods, so that when the torpedo strikes the water in falling from a height, the shock on the suspension points will not be too severe. The pendulum is connected with the front end of the lower tiller rod by a compound lever, *F. F.*, so as to increase its power. Assume that the torpedo is at its required depth, its axis horizontal, and its rudder amidships. Leave, for the moment, out of consideration the action of the hydrostatic piston, and assume that from any cause the bow of the torpedo is tilted down. The pendulum bob at once swings forward, and in so doing pushes the tiller rod back and forces the rudder up, thus tending to bring the torpedo to the horizontal again.

An examination of the combined action of the piston and pendulum shows a valuable feature. If the torpedo be pointed away from her proper depth line, and so long as she is leaving it, both piston and pendulum work the same way on the helm and combine their efforts to turn her back, but when she turns back, they commence to work against each other so as to ease her gently to her proper line, thus preventing violent oscillation.

This type of mechanism possesses several features of undoubted superiority over other automatic types, the most important of which are:

1st. In other types, whilst the mechanism controls the movement, the power necessary to operate the rudder and overcome friction of the working parts is taken from the motive power of the torpedo. All this power is a direct loss to driving power, reducing either speed, or range, or both. In this type the entire steering power is within the mechanism itself, releasing just that much of motive power to be used in driving the torpedo.

2d. When a torpedo strikes the water, no matter what the position of the rudder may be, it will receive a violent shock from the

impinging water. The pendulum, also, will receive violent impulses both from the shock of discharge of the torpedo and the shock of taking the water. In this type it will be noticed that when the torpedo is ready for discharge, since there is no pressure on the hydrostatic piston, the pendulum is drawn by the spring hard back against a small stop, *P*. It there has a proper and secure bearing against discharge shock. Upon striking the water the rudder is driven up and the pendulum is driven forward, but it will be noticed that the spring receives and eases both shocks, while, moreover, both act in the same direction on the tiller rod. That is, the upper movement of the rudder corresponds with the forward movement of the pendulum. No part is therefore submitted to an undue strain.

3d. The entire mechanism from its front end to the rudder yoke is within a length of two feet and is direct-acting. The force applied to the rudder is always a balanced one of give and take on equal arms each side of the rudder, instead of being all on one side, as in other systems. There is, therefore, less lost motion and a more direct application of power. The importance of this feature will be appreciated when it is considered that in any torpedo the extreme tiller-rod movement from hard up to hard down is never as much as half an inch.

4th. Owing to the compactness of the mechanism and its situation in a section of very small diameter, the water space, which represents a clear loss of buoyancy or carrying power of the torpedo, is reduced to a minimum.

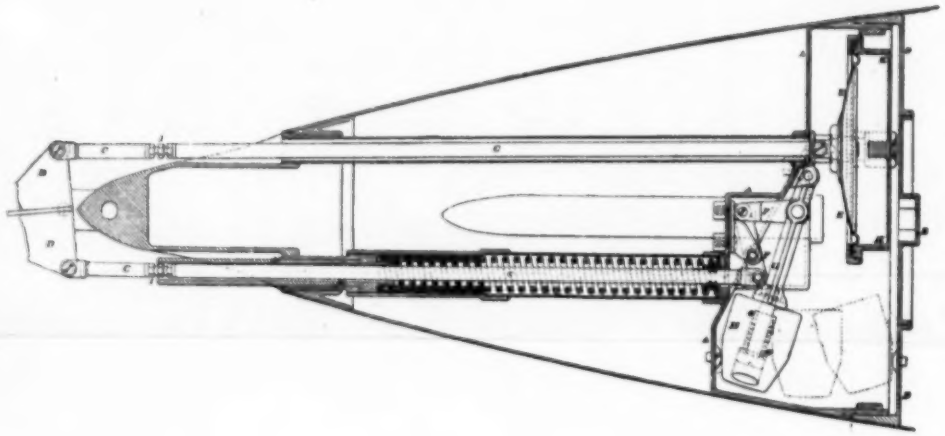
5th. All adjustments are simple, direct, and are made from the outside. The depth of immersion may be altered, lost motion be taken up, and the throw of the rudder be adjusted without the necessity of touching anything inside of the shell.

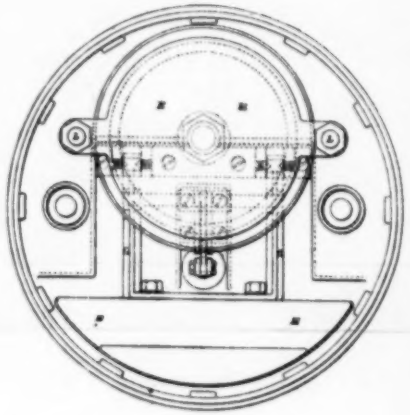
Finally, by removing the stern section the entire mechanism is laid bare and can be removed or altered without trouble or interfering with any other part of the torpedo.

### THE DOW STEAM TURBINE MOTOR.

Plate III.

Rotation is communicated to the fly-wheel by means of a steam motor which is a permanent attachment of the launching tube. The body of the Dow motor is a small cylindrical box about 8.75 inches in diameter by 4.5 inches in depth. The shell consists of a bronze casting, *a. a. a. a.*, having covers, *b. b. b. b.*, through-bolted





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to it, which have projections cast in one with them to form bearings for the main shaft. Two discs, *c. c. c. c.*, screw permanently into the wall of the shell, having in turn two smaller discs, *d. d. d. d.*, screwed into and forming a part of them. The interior of the motor is thus divided into three chambers, of which the central one, *e. e.*, receives the live steam direct through the steam pipe (not shown in the figure), and the two outer ones, *f. f. f. f.*, take the exhaust steam which passes out of the motor through the exhaust pipe *g*. The main shaft, *h. h. h.*, is journaled in the bearings formed in the covers and is given a longitudinal play, so as to permit clutching with and unclutching from the machine required to be driven. A sleeve, *i. i.*, covers the central part of the shaft, being keyed to it, but having a slight independent longitudinal play, and to this sleeve is secured a steel disc, *k. k.*, which partially divides the live steam chamber. Two bronze discs, *l. l. l. l.*, are also secured to the sleeve, and it is these discs that are revolved by the action of the steam, transmitting rotation to the main shaft.

Concentric ribs are cut on the opposing faces of the pairs of discs, *c. c. c. c.* and *l. l. l. l.*, which intermesh, and through these ribs a number of angular slotways are cut, those on the stationary discs being at an opposite angle from those on the revolving ones. The live steam entering the steam space *e. e.* passes into the space *m. m. m. m.*, and thence outward between the pairs of discs through their slotways, communicating rapid rotation to the revolving discs and shaft by expansion. After thus performing work, it passes into the exhaust chambers, *f. f. f. f.*, and out through the exhaust pipe. In passing outward through the slotways the steam undergoes seven expansions.

The function of the steel disc *k. k.* is to balance the work done by the two pairs of discs, since practically there are two motors or drivers mounted on a single shaft. Assume that for some reason the right-hand disc is driven harder than the left-hand one. The overpressure will force the right disc, and with it the sleeve and other discs, to the right, and by this movement the steel disc partially closes the right-hand steam entrance to the chamber *m. m.*, opens and gives more steam to the left-hand one, and thus automatically equalizes the driving force on the two revolving discs.

The left-hand end of the main shaft ends in a clutch, *n.*, and its journal, *o. o.*, is free to move longitudinally, carrying the shaft with it. The longitudinal clutching movement is communicated to the

shaft by the stud, *p*., which works in a guide-slot cut in the starting gear. (See Plate V.) The right-hand end of the shaft projects slightly beyond the end of the cover of the motor, and is hollowed to receive the squared end of an auxiliary shaft, which forms part of the tachometer.

### THE ELWELL TACHOMETER.

In such high speeds of rotation as are given by turbine motors, it is of great importance that a reliable speed indicator should always be attached. The Elwell tachometer is the most exact one known. Its indications depend upon the pressure of a column of oil acting upon an ordinary steam gauge, the dial plate of the gauge being marked in thousands of revolutions per minute. The pressure created on the column of oil is due to centrifugal force applied to the oil by the rotation of a small centrifugal pump. The body of the support of the gauge is a brass casting, *r*. *r*. *r*., whose inner end forms a collar clasping the end of the outer shaft bearing and tightened by a screw-bolt at *s*. The small hand-wheel *t*. *t*. attached to the auxiliary shaft does not belong to the tachometer, but is used when clutching up to engage the clutches. The cap *u*. *u*. screwing over the outer end of the support casting forms a small oil chamber connected with the tachometer gauge by the pipe *w*. Within this chamber and secured to the auxiliary shaft is a small cylinder having radial slits cut through it similar to the radial guides of a turbine wheel. As this cylinder is rapidly rotated, these slits force the oil out against the sides of the chamber with a pressure proportional to the centrifugal force developed, which itself is proportional to the speed of rotation. The pressure is communicated through the pipe *w*. to the gauge and acts on the pointer. The small conduit *x*. *x*. leads to an oil reservoir, *y*. *y*., which keeps the pump chamber constantly full of oil.

*z*. *z*. are oil cups for supplying oil to the main shaft bearings of the motor.

## PART III.

### LAUNCHING GEARS.

Although, in judging of the perfection of development of any type of automobile torpedo, its means of discharge is left out of account, this latter is so important an accessory that much of the efficiency of the complete weapon depends upon its own completeness.

In the first attempt at perfecting the torpedo the delicacy of its mechanism forbade the employment of any means of discharge by

which a sudden shock should be given. Nor could a torpedo be successfully launched from a height above water owing to the shock of impact and the tendency to dive very deeply. Compressed air therefore was resorted to as the expulsive force, and the point of discharge was brought as near to the proper depth line as possible. Both of these elements involved great difficulties of practical application. Compressed air discharge required complications of accessories and of details of the launching gears themselves. As the mechanism of the torpedo became simplified it was made less sensitive to shock, until finally gunpowder has been introduced for direct discharge; but hitherto this has possessed many drawbacks of its own which are very difficult of modification, amongst which the principal are: liability to derangement of the working parts of the torpedo from the impact of unburned grains of powder or the penetration of the powder fluids into its interior; fouling of the bore of the tube; danger of abnormal pressures in some part of the tube, due to a defect in the cartridge or the powder, as happens at times in guns.

In so far as the conditions of discharge themselves are concerned, it must be borne in mind that no matter how efficient a discharge may be, so long as the vessel from which it is made is stationary, such efficiency is no criterion whatever of results to be obtained with a vessel moving. Under-water discharge presents no difficulties whatever when made from a stationary point, but when made from a vessel at speed the drawbacks are very great. In beam fire from a vessel in motion it is apparent that the moment the nose of the torpedo shows beyond the end of the discharge tube, it will be swept violently aft, thus destroying the aimed direction entirely, and endangering the rear end of the torpedo, which may become jammed in the mouth of the tube. To counteract this defect it is necessary to project the guide-bar beyond the tube which will hold the torpedo in line until it is clear of the ship, and then let it go square or even. In straight-ahead fire a difficulty of another kind is met with that, it may be said in passing, is fatal to the success of the submarine gun.

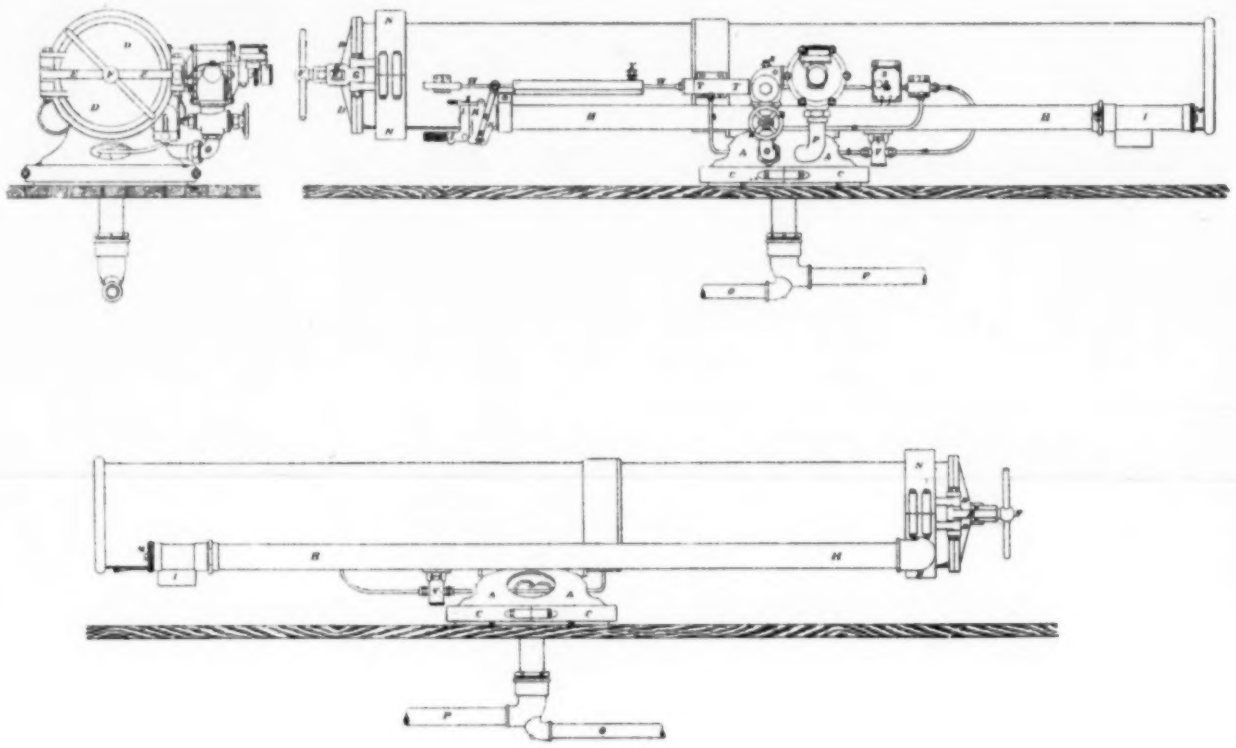
Consider a torpedo discharge tube mounted in the keel line of a ship, under water, its front end open and the ship going ahead at speed. The water inside of the tube has a pressure upon it due to the speed of the ship, but it has no flow, and if a body be placed within the tube it will move with the ship, for the water in the tube has an absolute velocity equal to that of ship. The moment, however, that this body is moved forward and leaves the tube, it enters water having no

motion with the ship, and at that moment the body becomes deprived of the driving force due to the speed of the vessel. Whatever be the absolute speed of discharge of the body, if it have no inherent propulsive force it will at once commence to lose speed from the resistance of the water, whilst the ship maintains her speed of advance, with the result that in the case of a submarine projectile, the ship will certainly overrun it. The same thing will happen with an automobile torpedo, unless its screws get a full driving power very quickly and give the torpedo a continuing speed, at least as great as that of the ship.

The moment that the keel angle of the discharge tube is altered to bow or beam fire, the difficulty explained as pertaining to beam fire begins to show itself. Here, then, are under-water difficulties of a most serious nature, entirely caused by motion of the point of discharge, and entirely absent when that point is stationary.

In so far as concerns the necessity for using a guide-bar to keep the front end of the torpedo from being violently swept aft in bow or beam fire, the Howell torpedo requires the application fully as much as the Whitehead. For straight-ahead fire, however, the Howell has a decided advantage over the Whitehead in that, previous to discharge, its screws are already working at full speed and commence to drive the torpedo from the instant it starts forward, so that in clearing the tube there is no check to the speed as occurs to the Whitehead, and consequently no danger of overrunning it.

In above-water discharge, as the Whitehead has no inherent directive force, every effort possible must be made to neutralize tendency to sheer. In beam or bow fire, if either the bow or stern strikes the water first, that end will be swept aft, or, what amounts to the same thing, its forward movement is checked, and consequently the torpedo is given a broad sheer. To counteract this, three precautions have to be taken: It is necessary to attach a long bar or spoon to the mouth of the discharge tube, to which the torpedo hangs itself in coming out and so is made to drop horizontally. If the ship happens to be rolling, the torpedo should be discharged at the moment when she is vertical, but even this will be ineffective if the torpedo has to strike into a wave. The angle of aim cannot be direct on the object to be hit, but allowance must be made for the inevitable sheer of the torpedo, which is always an uncertain amount. Finally the vertical rudder must be set to partially correct a rank sheer. This correction, however, is only of value to a certain point, as beyond it the torpedo will sheer in the other direction.



ISAAC FRIEDENWALD PHOTO-LITH. BALTO.

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The inherent directive force of the Howell torpedo quite obviates all these difficulties. No projecting spoon is required on the discharge tube, the aim is direct, and no heed need be taken of rolling, heeling or wave surface.

For straight-ahead fire above water, the chances of being overrun are the same in both the Whitehead and the Howell, as in both the driving power of the screws takes effect at the same time. It is an odd accident that in under-water fire the Howell has the advantage of the Whitehead in straight-ahead fire, and the two are equally handicapped in beam fire, whilst above water the conditions of advantage and equality of the Howell are reversed.

### THE ELWELL LAUNCHING GEAR.

The launching gear designed by Mr. Elwell, the Superintending Engineer of the American Branch of the Hotchkiss Ordnance Company, possesses a striking feature in the application of the expulsive force. The medium of discharge is gunpowder, but it is so applied that the explosive shock is cushioned against the torpedo, no fouling or solid particles enter the discharge tube, and although ordinary black powder is used, the discharge is practically noiseless and smokeless. The cartridge itself is also in the simple form of ordinary metallic cartridge case ammunition.

Discharge tubes differ in general arrangement, depending upon their emplacement; that is, whether under or over water, and whether fixed or pivoting. With the exception of the accessory features, however, a description of one apparatus will serve for all, as with all gears used for the Howell torpedo every effort is made to maintain as close a similitude as possible.

### THE CENTER PIVOT LAUNCHING TUBE.

Plate V.

This gear is designed for open-deck emplacements, where all-around fire is permissible.

The discharge tube is of bronze, bored to a diameter five hundredths of an inch greater than the midship diameter of the torpedo (14.25 inches for the general service torpedo). It is mounted upon a low, broad cone, *A. A.*, whose base rests on a bed-plate, *B. B.*, bolted to the deck, the two being held together by a stout clip-ring, *C. C.*, so that the cone is free to revolve. The interior of this cone

may be fitted with a rack and gears, so that the tube may be aimed from a conning tower if desirable. A shallow groove, *s.*, Plate III., is cut the full length of the tube along the bottom of the bore to carry the guide-stud of the torpedo. The rear end of this tube is closed by a door, *D. D.*, hinged to swing laterally, its inside edge being coned and ground to close air-tight. A steel cross-bar, *E. E.*, with a tightening screw, *F.*, through its center, is carried by the same hinges as the door, the free end of the bar being held by a stout bronze loop, *G. G.*, when the door is closed. To lock the door, it is closed, the loop is swung over the end of the bar, and a few turns are given to the tightening screw.

Two brass air tubes, *H. H. H. H.*, are secured to the main tube underneath, one on each side, being connected together at the front end by a cross-pipe, *I.* The tube on the right-hand side, called the firing tube, has screwed to its rear end a small bronze breech-piece, *K. K.*, which is chambered to carry an ordinary metallic cartridge case, and has a simple breech-block, *L. L.*, in which is fitted a hammer, sear and main-spring. The weight of powder used is less than half a pound, with which a discharge speed of over thirty-five knots can be obtained for a torpedo weighing nearly five hundred pounds. The front ends of both air tubes are closed by screw-caps, *M.*, that may be removed whenever necessary to sweep out the tubes. It will be noticed that the forward end of the firing tube is extended well beyond the cross-duct, *I.* This is done in order to form a lodgment for bits of wad or unburned grains of powder that by the explosion will be driven past the duct and be caught and held in this space, precisely as is the case with the cinder-trap of a locomotive engine.

The rear end of the left-hand pipe, called the compression pipe, connects by an elbow with the main tube. Around the rear of the main tube is secured a hollow strap, *N. N.*, into which the elbow of the compression tube opens. The wall of the tube underneath this strap is pierced all around with small square ports cut at an angle, such that the blast of air created by the explosion of the charge will be directed against the door of the tube first, instead of being taken directly on the tail of the torpedo. The air pressure thus created in the main tube drives the torpedo out. At a speed of ejection of about thirty-five knots, a torpedo discharged at a height of about five feet will take the water fully thirty feet from the ship's side.

It is well at this point to call attention to a feature of torpedo use

of great importance as affecting over and under-water discharge, that has hitherto not received noteworthy attention. A ship going into action probably will find it necessary to use her net, and if she is only provided with under-water tubes, all her torpedo fire is cut off by the net, whilst if she has tubes above water, she may discharge clear over the net.

The Dow motor is attached to the main tube on its right side, a hole being pierced through in the clutch-line. The steam pipe, *O. O.*, and the exhaust pipe, *P.*, to and from the motor, are carried down into the supporting cone, where a junction box is made, so that the steam pipe goes through the deck inside of the exhaust. This junction is swiveled to permit the system to revolve.

A throttle valve, with a hand-wheel, *R. R.*, gives steam, which is controlled by a regulator valve, *S.*, and there is also connected to the throttle an automatic cut-off.

It is of great importance that, once the torpedo is in the tube in place, the work of clutching, spinning up, unclutching, cutting off steam, freeing the torpedo and discharging it, should all be done in a simple manner, quickly, and with absolute certainty of the proper succession of movements. This work is almost entirely automatic, and is done in the following manner: The small box, *V.*, is a steam cylinder whose piston projects up through the main tube into and filling the slotway for the torpedo guide-stud and forming a stop. This piston is held up by a spiral spring underneath it. To load the torpedo into the tube it is simply necessary to push it in until its guide-stud brings up against this stop, and then close and fasten the door. The clutch hole in the torpedo is then directly in line with the motor clutch, and the moment that these clutches are thrown in action, the torpedo is held firmly against all movement.

A long rod, *W. W.*, performs the work of clutching, disconnecting and firing. The torpedo being in its tube, the powder charge may be inserted. Lift the small spring latch, *X.*, open the breech, and insert the cartridge. It is to be remarked that unless the torpedo is clutched up ready for spinning, it is impossible to cock the hammer, and unless the torpedo is entirely free to leave the tube, it is impossible to fire. The action of firing itself is automatic and is controlled by the lever, *Q*. By pulling back on the handle, *Y.*, the long rod, *W. W.*, is drawn to the rear, clutching the motor to the torpedo, and bringing the lever, *Q.*, into position, so that the movement of closing the little breech cocks the hammer. If the throttle valve be now

opened, steam is given to the motor, and the fly-wheel will be spun up, it being possible to so set the regulator valve that the wheel will run at any desired speed of revolution.

Discharge is operated in the following manner: A small box, *Z.*, contains an arrangement by which a small steam valve may be operated either electrically or by a firing laniard. The valve works instantaneously, and admits steam into the small pipe, *a. a.*, communicating with the stop-pin. Steam coming on the upper side of this little piston forces it down so that the pin comes clear of the guide-stud on the torpedo, leaving it clear to leave the tube. As this piston descends, *and after withdrawing the stop*, a port is unmasked, admitting steam to the pipe, *b. b. b.*, passing to the cylinder, *T. T.*, whose piston is attached to the long rod, *W. W.*, driving it forward. As the rod moves forward it first unclutches the motor, then cuts the steam off from the motor, and finally, at the end of its course, trips the hammer and fires the cartridge. Thus all the movements are performed automatically, and they can only occur in their proper succession. The entire time from pulling the firing laniard until the torpedo leaves its tube is but little over one second, most of this time being taken by the torpedo itself gathering movement.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MARCH 1, 1890.

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# DESERTION, AND THE BERTILLON SYSTEM FOR THE IDENTIFICATION OF PERSONS.

BY LIEUTENANT ALEXANDER MCCRACKIN, U. S. NAVY.

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The subject of desertion from the army and navy has been discussed by many persons, and the causes assigned for desertion, with the methods proposed for its prevention and punishment, have been almost as numerous as the number of writers.

It may be taken as an axiom that desertions will always occur. Cases are on record of officers deserting, and the writer has questioned an enlisted man apprehended for desertion, who admitted that he had been well fed and clothed, well treated, had received plenty of liberty, that he had no real cause of discontent, and that he had previously deserted from the Marine Corps! No doubt there will always be such men.

It is idle to write of the evils of desertion and its punishment when wholesale amnesties to deserters are made, and when such principles are promulgated as these by a Senator who lately wrote of desertion as being "an offense which evidences no lack of patriotism and involves the least possible moral turpitude"!

If desertion ended a man's connection with the navy the latter would be the gainer, but unfortunately the deserter thinks it is quite the proper thing to go to another ship, re-enlist under a different *alias*, stay in the new ship long enough to once more become a factor of discontent and disorganization, and then desert again, and so on. Men who have been dishonorably discharged adopt the same course.

As, probably, no humanitarian would desire to thus burden the service, the only question now left of the whole subject of desertion is, how shall the Government be protected from such frauds?

The plan which has been repeatedly recommended officially in the army as the best remedial measure is prohibited in the navy by the 49th Article for the Government of the Navy, which forbids the "branding, marking or tattooing on the body."

There exists, however, a method to which the most fastidious humanitarian cannot possibly raise any objection, viz. the use of photography, and a more exact system of measurements and personal description in the enlistment records than that now in vogue.

There is one system for identifying persons that was inaugurated in Paris in 1882, and which has given such excellent results that it is now used throughout France and is being generally adopted in Europe and the United States, viz. the *Anthropometrical System* of M. Alphonse Bertillon.

The Navy "Descriptive List" gives a man's name, age, place of birth (the foregoing being furnished by the man himself), height, weight, color of eyes and hair, complexion, and permanent marks or scars. The defectiveness of such a description is shown from the personal measurements and observations made in Paris by M. Bertillon with over 10,000 subjects; he found that among a hundred persons of the *same height*, 87 had what is commonly called "brown hair," 10 had blonde hair, 2.7 black, and 0.3 had red hair; one-third had hazel eyes, one-fourth gray, one-seventh blue, and one-fourth of indistinct color.

The identification of a person by the Bertillon system rests on the following measurements:

1. The length and width of the head.
2. The length of the left middle and little fingers.
3. The length of the left foot.
4. The length of the left forearm.
5. The length of the right ear.
6. The height of the figure.
7. The length of the outstretched arms.
8. The length of the trunk.

Perhaps the best concise description of the Bertillon system is that which first appeared in the *Pall Mall Gazette*, and is by the inventor himself. During the last Paris Exhibition the *Gazette* correspondent went to the measurement and identification department in Paris, which is in the Palais de Justice, where he found M. Bertillon "operating in a large square room. There were shelves on one side containing thousands of cards, with the photographs and records of

criminals. Several assistants were busy taking measurements to add to the collection.

"My system for identifying criminals, said M. Bertillon . . . . is now in operation throughout the whole of France. It was found that many old offenders escaped detection. The classification of criminals under their names was not satisfactory. It is in their interest to keep their antecedents hidden and to give false names. The Paris police had amassed in ten years 100,000 photographs, but it was impossible to search this collection every time an arrest was made. Now, the search can be made in a few minutes. We now classify our photographs and cards giving the antecedents of prisoners, under measurements based on a system of anthropometrical descriptions. This system is simple and certain. Identification does not depend on the uncertainty of a name or the doubtfulness of a photograph. We take no notice of names, and photographs might be dispensed with. Criminals are classified under measurements of certain bony parts of the human frame. We have here 60,000 photographs and cards with the record of adult male prisoners who have passed through the hands of the police. We begin our classification with the measurement of the length of the head. We found by experience that it was better to begin with the head than the stature. The size of the skull cannot be changed, but prisoners refuse to stand up straight when their height is being taken. The exact height could not be obtained except to within three centimeters, while the length of the head can be measured to a millimeter. We divide the length of the head into three classes—short, medium, and long—which reduces our collection to 20,000. Then we take the width of the head, and making three subdivisions—of narrow, medium, and wide—we have 6000 left. Next, we take the length of the middle finger, and again making the three classes, as we do with all our measurements, we have 2000 left. We continue on the same system with the measurement of the foot, the forearm, the height, etc., until we reduce our collection of 60,000 photographs to 6. But you will see the system in operation.

"Call in that man who was arrested on the race-course yesterday, said M. Bertillon to an assistant. The charge against the man was watch-stealing, but he swore it was all a mistake.

"Have you ever been here before? *Mon Dieu*, no.

"Never been measured here? Certainly not.

"Where did you come from? Geneva.

"Where did you reside last? Brussels.

"A peculiarity of the international thief, remarked M. Bertillon. The prisoner submitted calmly to be measured. He was placed on a stool and the length of his head taken with a special compass made for the purpose. One leg of it was placed in the hollow above the bridge of the nose and the other moved round to find the greatest length behind. The compass shows the length to a millimeter. Next, the breadth of the head was taken from one parietal bone to the other. Another instrument was used for taking the length of the middle finger. These three are the surest measurements, said M. Bertillon, and give the best results. The measurement of the left foot was next taken. The prisoner was barefooted, and was made to stand on the left foot when its measurement was being taken. The process continued with the length of the ear, of the forearm, length of the arms extended, the height, and the color of the eyes. The color of the eye is registered according to the intensity of the pigmentation of the iris, but it requires some experience to record this description accurately. It is used most in classification of young persons who have not reached maturity. After the man was measured, a search of five minutes showed that he was an old thief who had been expelled from France and was now liable to a very heavy punishment."

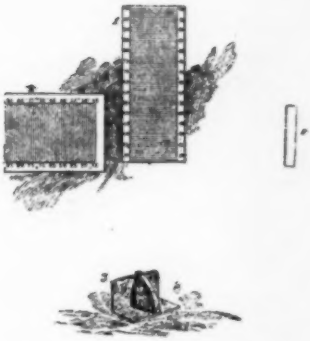
It will be observed that the primary object of the measures taken is for the purpose of classification—*small*, *medium*, and *large*, or their equivalents, being the divisions used throughout a classification or file—and their principal benefit is in eliminating from a collection of descriptions all except what are in the division of the description sought for; the minute description of features, color of eyes and hair, permanent marks and scars, and photographs, being relied upon to establish the *identity* of the subject in hand, *after* the number of descriptions to be considered has been reduced to a minimum by the previous eliminations.

The sketches show the instruments used, also the manner of taking the measurements and recording them. For the purpose of uniformity the metric system is used, and for the same reason the small book of simple instructions should be followed strictly.

The following measurements of Mr. Geo. M. Portius, of the *American Bertillon Prison Bureau*, Chicago, Ill., taken at different times and places, give an idea of the extreme accuracy of the system:

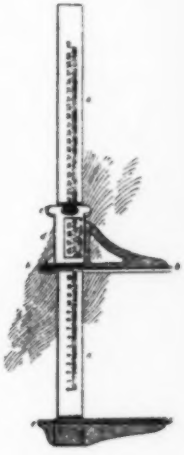
CALIPER COMPASSES.

For measuring the head.



VERTICAL, HORIZONTAL, AND SQUARE MEASURES.

For measuring heights and outstretched arms.

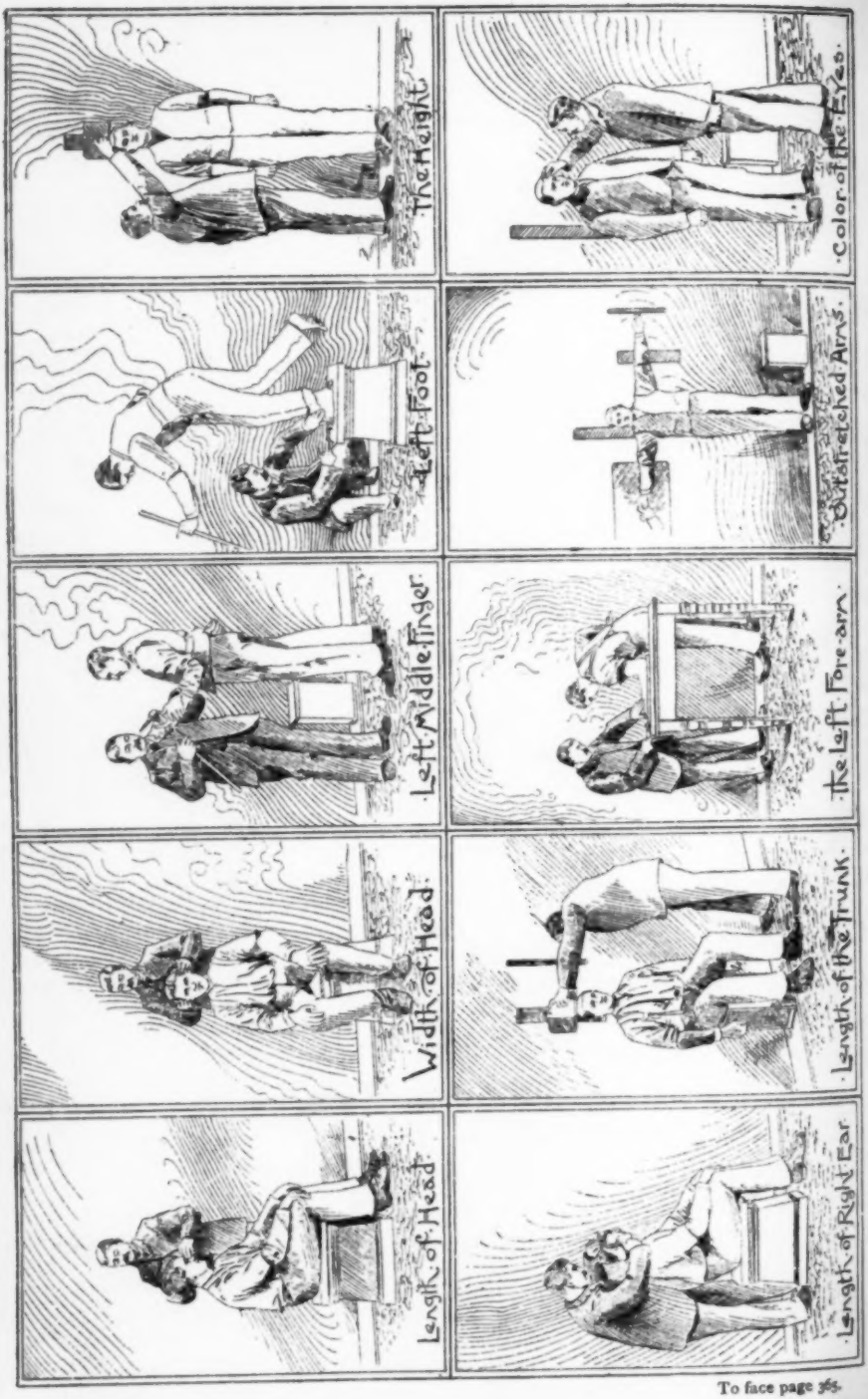


SLIDING COMPASSES.

For measuring the ear.

For measuring the foot, forearm, and middle and little fingers.

To face page 364.




To face page 365.

| WHERE TAKEN. | OPERATOR. | Height. | | Out-Stretc'd Arms. | | Trunk. | Head. | | | | Right Ear. | Left Foot. | Left middle finger. | Left little finger. | Left fore-arm. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Length. | | Width. | | | | | | | |
| | | Metre. | Cent. | Metre. | Cent. | Cent. Milli. | Cent. | Milli. | Cent. | Milli. | Cent. Milli. | Cent. Milli. | Cent. Milli. | Cent. Milli. | Cent. Milli. | |
| Joliet, Ill | M. H. Luke | 1. | 763 | 1. | 79 | 93.7 | 19.5 | | 15.6 | | 6.7 | 27.2 | 11.7 | 9.3 | 46.2 | |
| Jackson, Mich | A. C. Northrup. | 1. | 755 | 1. | 79 | 93.6 | 19.7 | | 15.6 | | 6.6 | 27.3 | 11.8 | 9.4 | 46.1 | |
| Detroit, " | H. Wolfer | 1. | 766 | 1. | 79 | 93.7 | 19.5 | | 15.6 | | 6.6 | *26.8 | 11.7 | 9.3 | 46.1 | |
| Chicago, Ill | G. Bingley | 1. | 76 | 1. | 79 | 93.4 | 19.6 | | 15.7 | | 6.7 | 27.2 | 11.8 | 9.4 | 46.4 | |
| " " | F. Ferrier | 1. | 759 | 1. | 79 | 93.4 | 19.6 | | 15.7 | | 6.6 | 27.3 | 11.8 | 9.5 | 46.3 | |
| Allegheny City, Pa | A. F. Sawhill | 1. | 753 | 1. | 79 | 93.3 | 19.5 | | 15.6 | | 6.7 | 27.2 | 11.8 | 9.4 | 46.4 | |
| Chicago, Ill | W. McClaughry | 1. | 766 | 1. | 79 | 93.7 | 19.5 | | 15 7 | | 6.6 | 27.2 | 11.8 | 9.4 | 46.1 | |
| " " | Operator No. 1 | 1. | 766 | 1. | 79 | 94.0 | 19.5 | | 15.7 | | 6.7 | 27.2 | 11.7 | 9.4 | 46.2 | |
| " " | " " 2 | 1. | 765 | 1. | 79 | 94.0 | 19.5 | | 15.7 | | 6.7 | 27.2 | 11.7 | 9.4 | 46.2 | |
| Paris, France | Alphonse Bertillon | 1. | 76 | 1. | 79 | 94.0 | 19.6 | | 15.6 | | 6.6 | 27.2 | 11.8 | 9.4 | 46.4 | |

*"The *foot* measurement is the *only* one not within the permitted limit of variation. Caused by too great a pressure upon the instrument used."

Slight changes, in the headings only, need be made to adapt the description cards to the Navy Enlistment Record. The system can be used on board vessels which are not supplied with a photographic outfit; for while the photograph is an additional aid in identification, it is not a necessity.

All descriptions being sent to the Navy Department in Washington, the person in charge of the Enlistment Records would soon become very familiar with them and their use.

A bill has lately been introduced into Congress to establish a "Prison Bureau," with "a central office for the identification of criminals." If a *Tascott* be wanted by the "Commissioner of Prisons," he can inspect the files in the War and Navy Departments, and ascertain with certainty whether or not his man has sought security by enlisting in the army or navy,—provided the Bertillon or some similar system be generally adopted.

Not only would the adoption of the Bertillon method of measurement and registration, or such other method as shall minutely describe enlisted men in the army and navy, lead incidentally to the immediate detection of deserters and the dishonorably discharged men who have re-enlisted, but it would further protect the Government by furnishing a sure identification of the holders of honorable discharges, and also of applicants for pension.

SPECIMEN OF DESCRIPTION CARD. FILLED OUT. (Full size.)
(Face).

| | | Rem. | | | Rem. | | | Rem. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Height, | i m. 67 | | Head, lgth. | 19.1 | | L. Foot, | 27.6 | (1)(1) | Color of Left Eye. Circle, )) | )) | Age, 28 years. |
| Stoop, | 2. | | " width | 15.2 | | " Mid F. | 11.2 | | Periph, Z-yl bl-m | | |
| Outs. A, | i m. 75 | | Rgt. Ear lgth. | 5.6 | | " Lit. F. | 4.8 | Note | lim-y | | Born in |
| Trunk, | 92 | | Rgt. Ear width | | | " Fore A. | 45.8 | | Pecul. | | Illinois |

Remarks incident to Measurments, Two phalanges of left l. finger amputated. R. l. f. 8. 9.

(Profile.)

(Full face.)

DESCRIPTIVE.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Forehead | Incl. recéd'g | Nose. Profile. | Ridge, conc. | Right Ear. | upper rim | Beard, sandy Hair, l. chest | |
| | Hght. m. | | Base, elev. Root, m. | | indented. | Complexion, fair. | |
| | Width, m. | | DIMENSIONS. Length. / Projection. / Breadth. | | lower bruised. | Weight, 160 lbs. | |
| | Pecul, | | m / prom / narrow | | | Build, medium. | |
| | | | Pecul. twisted to left | | Chin, pointed | | |

Measured at Joliet, March 19th, 1888, by M. H. Luke.

Remeasured, When and Where,

To face page 366.

SPECIMEN OF DESCRIPTION CARD, FILLED OUT.
(Reverse.)

*Institution,* Illinois State Penitentiary. *Reg. No.* 642.

*NAME,* John Smith.

*Alias,* Jack Smith, alias "Slick Jack."

*County,* Cook. *Crime,* Burglary. *Sentence,* 3 Years.

*Occupation,* Tailor *Descent,* Irish.

*Known or Admitted Former Imprisonment,* Done time in Sing-Sing. 2 years;
Columbus, O, 1 year for Burglary

MARKS, SCARS AND MOLES.

| NUM'RC'L ORDER | | NUM'RC'L ORDER. | |
|---|---|---|---|
| I. | Hor. cut sc. 4 ct 10 c. above elb frt. | IV. | Mole, 5 c. ab. and front r. |
| I. | Mole, 5 c. below shoulder out. | | nipple 8 c. below fork. |
| I. | Anchor tattoed 3 x 2 14 ct | | |
| | above wrist front | V. | Carb 4 c. below 7th, 3 c. to left |
| | | | of column. |
| II. | Split Nail M F. | V. | Rect. sc. obl. inw. 4 ct. 30 ct. |
| | | | below 7th 13 c left of col'm. |
| III. | Sc. obl. form. cav. upw. | | |
| | 3 ct. l. temple. | VI. | Gunshot ent. g.l. thigh fr. out. |
| III. | Sc. obl. backw. cav. downw. | | upw. direct. out rear. |
| | 15 ct. r. eyebrow out. | | |
| | | | |
| III | Wart 2 c. below lobule r. ear. | | |
| | | | |

NOTE.—Please follow strictly Book of Instructions not only as to measurements and general description, but also particularly as to Marks, Scars, etc. See page 72 to 87. Use abbreviations as given in Instructions.

The Roman Numerals refer to the parts of the body.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.
MARCH 1, 1890.

# NAVAL TRAINING.

BY REAR-ADMIRAL S. B. LUCE, U. S. N.
*President of the U. S. Naval Institute.*

The naval policy of the United States, confirmed by many years of practice, is to maintain a very small floating force. That a similar policy will be continued in the future there can be no reasonable doubt. Such is the will of the people, and naval officers, while accepting the popular decree, must endeavor in good faith to make up for numerical inferiority by excellence of organization and thoroughness of drill. Military and naval histories are not wanting in great examples of discipline more than compensating for disparity of numbers.

Hence, as a supplement to the policy of keeping up a comparatively small navy, must come the policy of greatly increased attention to the question of reserves and to all the exercises which can best prepare the personnel for the great object to which it owes its existence —war. To furnish the best results, these exercises should be carried on systematically and progressively from early youth to mature age.

War is the best school of war; but if we can substitute some other and less expensive method of instruction, we go just so far towards attaining that state of preparation which is the surest guarantee against war. For if war is the great object in maintaining a military and naval establishment, the prevention of war is a still greater object. That fact cannot be too strongly emphasized. The prophylactic system is the wisest in this as in other cases, and it is just here that we find ourselves in touch with the Universal Peace Societies.

It is the trained athlete who enjoys the greatest immunity from aggression. The cloud of war which has so long been hovering

over Europe has not burst, simply because all the great powers are prepared for it.

The ideal system of training comprehends mental, moral, and physical culture. One of the deepest thinkers and closest reasoners of modern times remarks that the man who, in danger or upon the approach of death, preserves his tranquillity unaltered, and suffers no word, no gesture to escape him which does not perfectly accord with the feelings of the most indifferent spectator, necessarily commands a very high degree of admiration.

The heroes of ancient and modern history, he continues, who are remembered with the most peculiar favor and affection, are, many of them, those who in the cause of truth, liberty, and justice have perished upon the scaffold, and who behaved there with that ease and dignity which became them.

War, he explains, is the great school for acquiring and exercising this kind of magnanimity. Death, as we say, is the king of terrors, and the man who has conquered the fear of death is not likely to lose his presence of mind at the approach of any other natural evil. In war men become familiar with death, and are thereby necessarily cured of that superstitious horror with which it is viewed by the weak and inexperienced. They consider it merely as the loss of life, and as no further the object of aversion than as life may happen to be that of desire; they learn from experience, too, that many seemingly great dangers are not so great as they appear, and that with courage, activity, and presence of mind, there is often a good probability of extricating themselves with honor from situations where at first they could see no hope. The dread of death is thus greatly diminished, and the confidence or hope of escaping it augmented. They learn to expose themselves to danger with less reluctance; they are less anxious to get out of it, and less apt to lose their presence of mind while they are in it. It is this habitual contempt of danger and death which ennobles the profession of the soldier, and bestows upon it, in the natural apprehension of mankind, a rank and dignity superior to that of any other profession. The skillful and successful exercise of this profession in the service of their country seems to have constituted the most distinguishing feature in the character of the favorite heroes of all ages.

The word "soldier" is used here in its generic sense, and applies equally to those who fight under the flag of their country, whether at home or abroad, whether on land or at sea. But if we make a

distinction between those who embrace the profession of arms on land, or the "soldier" proper, and those who pass their lives at sea in the service of their country, then are the observations in respect to the profession of the soldier far more applicable to that of the sailor.

During long years of peace the life of a soldier is one of comparative inactivity, and unattended by those dangers that "try men's souls." It is not so with the sailor. For although his country may enjoy continuous peace, yet he himself is constantly battling with the elements. His whole life may be said to be passed in confronting danger.

"They that go down to the sea in ships, that do business in great waters, see the works of the Lord and his wonders of the deep; their soul is melted because of trouble, and they are at their wits ends," was not written by the Psalmist of men who pass their lives in ease.

The constant contending with winds and seas develops those rare qualities in the sailor, the exercise of which is demanded in a like degree by no other calling. Of this familiarity with difficulty and danger comes a contempt for it, as was remarked of the soldier inured to war. Hence that quality of reckless daring so characteristic of the sailor—a quality of inestimable value in war.

Formerly, the best and most thorough school of training for the young seaman was on board the merchant sailing ship engaged in foreign trade. This was due to the smaller crew of a merchant ship as compared to a ship-of-war, and, as a consequence, the greater and more constant demand for personal exertion; to the more economical fitting of rigging, sails and spars, which increased the chances of casualties; and to the urgent necessity for making quick passages in the interests of the owners, which required the "carrying on" of sail. A youngster's first tussle with a royal in a fresh breeze will long live in the memory of the man. He has no time to feel dizzy or sea-sick, nor does it matter whether he hangs on by his teeth or his toes. He must, unaided, roll up that royal and pass the sea-gasket, and do it, too, in a reasonable time, or somebody would know the reason why. From that he goes to wrestle with an obdurate topgallant-sail in a stiffish blow; to stowing a jib when every 'scend of the ship would seem to plunge him in the angry seas; to taking in a close reef. Rain and sleet and snow and ice and dark nights, and gleams of lightning giving a transient view of the wild seas, and deafening thunder, are accompaniments which he must take as they come.

"Though the tall mast should quiver as a reed,
And the rent canvas, fluttering, strew the gale,
Still must he on ——"

The wonder often is that he can do any work at all aloft under such circumstances; that he has any mind or strength beyond that which is absolutely necessary to self-preservation.

### THE SCHOOL OF THE TOPMAN.

No one can deny that what may be called the school of the topman on board a man-of-war is, or at least at one time was, one of the most difficult and perilous that could be undertaken by men in time of peace. Seafaring people whose duties rarely, if ever, carry them above the vessel's rail, are often appalled by the dangers of the sea. What, then, shall be said of those whose habitual duty is high up on the "giddy mast"—far above the rail? The duty of the young sailor on board a square-rigged sailing vessel is principally aloft, where it would seem to require all his care and strength to keep from falling to certain death. This is true even under the most favorable circumstances, as, for example, when loosing, furling, bending or unbending sails while at anchor and in pleasant weather. The slipping of the foot, the missing of the hold, or the parting of a rope may readily send one to inevitable destruction. How much, then, are those risks increased when the ship is in heavy weather at sea! One would suppose that at sea the sailor aloft had as much as he could do to hold on for dear life, to say nothing of doing anything like real work. But sail must be reduced as the storm comes on, and the "common sailor," as he is called, must reef and furl, as the case may be, let appearances be never so uninviting; for the safety of sails and spars, nay, of the ship itself and all her crew is often dependent upon his exertions. He is cool and self-possessed in the presence of this imminent danger, and works as only brave and hardy men long accustomed to danger can work, and the sails are reefed or furled and safety insured through his courage and endurance.

Heavy rain-squalls may make the canvas as hard and stiff as boards, and blinding snow-storms benumb his limbs, and night add its terrors to the scene, till the heart of the boldest may well quail with fear, and yet the true sailor, noways daunted, speeds him to his task. It is not uncommon to find "ordinary" seamen, not wanting in manli-

ness, but whose previous experience has been confined to "fore-and afters," absolutely refuse under such conditions to lay out on the yards. They would, as far as they were concerned, allow the sails to thrash themselves to ribbons first, and no coaxing or driving could induce them to leave the security of the tops.

Thorough seamen, on the other hand, would lay out on the yards, not only without fear, but with a certain degree of cheerfulness, let it blow high or blow low, and having accomplished their end, would come down from their perilous labors with the utmost unconcern, just as if their conduct were not beyond all praise. This total unconsciousness of his own high merit is certainly not the least admirable trait of the sailor's character.

The two representative seamen just referred to, the one who braves danger and he who shuns it, form an interesting and instructive study. On deck, in pleasant weather, there is to the casual observer little to distinguish one from the other in their capacity of sailor; but viewed under the conditions just depicted there is a marked contrast.

In the one, the entire mental, nervous, and muscular systems are under the absolute dominion of the instinct of self-preservation. To grasp and retain hold of the nearest object which promises adequate support engages his whole thought. He is breathless through his exertions in going aloft, bewildered by the warring of the elements and a general sense of insecurity, and the sum of all the work of which he is capable is to save himself from being blown out of the rigging into the raging sea.

In the other we find total self-abnegation. The rolling and pitching of the ship, the loud flapping of the canvas heard above the howling gale, the surging of the yard, the driving rain, the blackness of the night, all combined have no terrors for him. With no thought of himself, his energies are all centered in the work before him. How he manages to get from the rigging to the yard and thence to the yard-arm, and why when there he is not shaken off into the sea, seems little less than a miracle. But he is there for a purpose, and that purpose he accomplishes, and accomplishes well. For the time and place, he is possessed of all the attributes of heroism.

Says a recent writer on physiology: "The man accustomed to use his muscles seems to obtain from them, *without effort*, a much more considerable amount of work, and this without an increase in the muscular fibers sufficient to account for the greater ease with which they contract. The nerve seems to transform a moderate stimulus,

which passes along it, into an energetic one, and a *man accustomed to work performs, without effort of will*, movements which would formerly have caused him excessive voluntary strain."

"*The power of automatism acquired by daily practice comes to our aid constantly in the performance of difficult and rapid movements.*"

"It is incontestable that certain faculties of the soul come into play in bodily exercise to excite the contraction of muscles and to co-ordinate movements; it is also incontestable that these faculties are improved and developed by exercise."

"The faculties which preside over the co-ordination of movements are developed by the performance of difficult exercises, and their improvement endows a man with the quality we call skill."*

It is impossible for any young man to go through the school of the topman and become an able seaman, referring always to the sailing ship, without having his moral being permanently affected by it. Indeed, it is well known that such an experience does affect character, and has endowed the sailor with those high qualities of self-reliance, endurance, courage, and patience under difficulties which have always characterized him.

We venture here to quote Dr. Lagrange once more:

"The faculty which orders a muscle to act and which gives it the stimulus necessary for its contraction is called the *Will:* it also is developed and improved by the repeated use made of it. It shows its acquired superiority in the sphere of movement by a greater persistence of effort, by a greater tenacity in muscular action. The person who every day, *in spite of the different pains of fatigue, sustains energetic and prolonged muscular efforts*, acquires a greater power of *Willing*, and from this acquisition result certain very striking changes in his moral disposition. The habituation to work gives to a man greater energy of will considered as a motor force, and from this change of a moral order, as much as from that of a material order, results a particular form of courage which we may call *Physical Courage.*"

"Physical courage is manifestly increased by the practice of muscular exercises. It is almost exclusively in men whose daily work is

* Physiology of Bodily Exercise. By Fernand Lagrange, M. D. The International Scientific Series. D. Appleton & Co., New York. This work is commended to all interested in education in general and physical culture in particular.—S. B. L.

laborious, or who are given to violent exercises, that we see bold and energetic actions. The practice of muscular work and the habituation to bodily exercise dispose a man to brave all forms of material danger."

"In difficult exercises [such as our topmen were formerly subjected to], all the *psychical* faculties associate in the work of the muscles; hence arise the most characteristic conditions of difficult exercises: they need brain-work. Judgment, memory, comparison, will, such are the *psychical* factors which preside over their performance. The cerebrum, the cerebellum, the sensory nerves, are organs whose very active concurrence is indispensable."

Seamen accustomed to running up the rigging four and five times a day, sometimes when at sea oftener—itself one of the severest of physical exercises,—to constant rowing in boats, often for long distances, and the handling of heavy guns, put forth "energetic and prolonged muscular efforts" to an extent hardly contemplated by the author.

The abolition of sails, the use of the hydraulic or pneumatic gun-carriage, and the indiscriminate use of the steam-launch has put an end, in a very great measure, to such severe physical training. This by way of parenthesis. To continue:

The school of the topman was, literally, the school of danger, as we have seen, and it prepared the man-of-wars-man, as no other school could, for his duties at the gun. The gun-captain, above all, must be possessed of those very qualities which were the product of the severe training of topmen—physical courage, self-possession, endurance, and the automatic movements due to habituation.

There is, or at least there was, not a little in the training of the young sailor that reminds one of the Spartan youth as moulded by Lycurgus after the Dorian model. The young Spartan was reared to a life of hardship, privation, and discipline. He was trained to courage, and taught acuteness, promptness, and discernment—qualities essential to a soldier. Such an education, the historian tells us, produced an athletic frame, simple and hardy habits, an indomitable patience and quick sagacity. "Their bodies," says Gillies, "were early familiarized to fatigue, hunger and watching; their minds were early accustomed to difficulty and danger."

Somewhat analogous to the training of the sailor as a preparation for war on the ocean, was the chase as a preparation for war on land. The chase was not inappropriately termed "mimic war."

Wellington was always ready to praise the dash, courage, and endurance of his regimental officers, the sons of English squires and the younger sons of the aristocracy. They had been brought up to ride to the hounds, and to acquire, in early youth, a quick eye, a ready hand, and a good digestion. With these came the moral qualities, courage and endurance. The history of our own wars furnishes similar examples.

### THE DECK-HAND.

In attempting to present a picture of the sailor "handing and reefing" in bad weather, there is no wish to convey the idea that bad weather is the rule at sea, or that the sailor was always to be found at the weather-earring. On the contrary, during a three years' cruise on some stations, the gale may prove a rare exception. The point is simply that when the danger does come, the sailor, by virtue of long training, is prepared to meet it, not only on the topsail yard, but wherever it may overtake him or in what form soever it may come. Battle is only another form of danger, and as he has but one life, it makes little difference to him whether he loses it at the hands of an enemy or through the perils of the sea.

It is an interesting question as to how far the character of the sailor, as heretofore known, has been and is yet to be modified by the use of steam as a means of propulsion.

By the multiplication of steam machinery the artisan is saved much labor, and the sailor has come in for his full share of the manifold benefits conferred by steam.

It is no longer by his constancy and skill that his sails are trimmed to the ever varying winds and his vessel turned again and again to her course. The powers of a thousand horses are now harnessed in his service, and his vessel is driven on in spite of winds and seas. What labor he is saved! What days he is spared of baffled skill and deferred hopes and all their chastening influences! What dangers he escapes! What exemption from a thousand perils! To-day the sailor may enjoy his repose on deck even during the heaviest gale at sea, albeit the firemen and coal-heavers are sweating out their lives feeding the insatiable maw that creates the motive power.

Formerly to get a frigate under way and stand out to sea required the presence on deck of the entire crew. It was an operation that called for the exercise of skill on the part of the officers, and the

utmost promptness and alacrity on the part of the sailors. The same was true of entering port and coming to an anchor. How is it now? The complement of the Chicago is, let us say, three hundred and eighty-odd men. Of these there will be about one hundred belonging to the engineer's force. Throwing out the latter and the special class of petty officers, messmen, band, etc., there will be left about two hundred and ten or fifteen petty officers, seamen, landsmen, and boys. Of these two hundred and ten or fifteen it requires just two to take the ship to sea—one at the steam steering wheel, the other at the lead. We are not considering the engineer's force. That force does all the work in getting up steam, firing, running the engines, etc. Our present inquiries lead us to the deck. There we find, in round numbers, some two hundred seamen of various classes. What part do they take in getting the ship to sea or on entering port? No part whatever. It is proper on such occasions to station hands at the life-buoys, at the engine-room bell, on the lookout, at the signals, and the life-boat's crew at their boat ready for service. These are all positions of inactivity, calling for no mental or muscular exertion. On going to sea, the anchor once catted and fished, which may be done chiefly by means of a steam winch, the man at the wheel and the man at the lead are the only two of the two hundred who are called upon to take an active part in the operation. The one hundred and ninety-eight might as well be asleep in their hammocks for all the use they are in the management of the ship. So far from being of any use, the question is what to do with the crowd of men who are lounging about the decks. And it is this same question of what to do with the crew, how profitably to employ them, that frequently comes up on board the sailless steamer.

In bad weather at sea the steamship sailor will naturally "get in out of the rain." There is nothing in particular for him to do, and he does nothing but make himself as comfortable as circumstances admit. The man at the wheel is sheltered by the pilot-house; the men on the lookout alone have to expose themselves.

It is to the mercantile marine that navies in general look for their reserves of seamen in time of war. Let us consider then, for a moment, what kind of sailor the mercantile marine is producing. The great majority of tonnage in that service is found in steam vessels. The crews are made up of the engineer's force and the deck-hands. The latter have comparatively little work to do. The merchant

steamer, when loaded by stevedores, casts off her lines, steams out from her dock and proceeds to sea. There is one man at the wheel. As the pilot takes charge, there is no one at the lead. The crew clear up the decks and make everything secure for sea. Thanks to steam, there is little or nothing for the deck-hand to do while at sea. On reaching her port of destination the vessel goes to her dock, throws out her lines and makes fast. Voyage after voyage is made without even so much as lowering a boat.

With such slight demands on the muscular and mental activities, the deck-hand could not exist on the food once thought good enough for a sailor. Fortunately, with the change in the mode of life comes a greatly improved dietary system. But even with the latter improvement, it does not seem possible that the deck-hand can get enough bodily exercise to keep him in the best condition. Says Lagrange, to quote that authority once more, "Muscular exercise has a considerable influence on the process of nutrition, and it is to this influence that are due the changes which occur in the conformation of a person whose muscles are habitually in action." What comes of no muscular exercise?

There are numerous examples of individual heroism among deck-hands, but it can scarcely be said of them, as a class, that their daily labors are such as to contribute to a high physical development and the physical courage which accompanies it.

Another quality found in the sailor was his contentment with ship life. He was, to borrow a phrase from the scientist, in perfect correspondence with his environment. The long sea-voyages in sailing ships during his minority habituated him to the life and its attendant hardships. He soon learned to content himself with an environment which would be intolerable to a landsman. But, owing to the quick passages made by steamers and the comparatively short time actually spent at sea, the deck-hand does not become habituated to ship-life—his preference is for the shore.

In the event of our becoming engaged in a maritime war, the deck-hands of our merchant steamers would soon find their way into the navy and form parts of the complements of our crews.

This would not be so deplorable as at first glance might seem, for the tendency in the navy itself is to man our ships with deck-hands. We say the tendency is in that direction, how far off soever may be the end to be accomplished.

Let us begin, as has been suggested, by putting the naval appren-

tice in barracks on shore, where he may be perfected in infantry drill, with a little marline-spike seamanship thrown in. After a course of soldiering on shore he will be put on board a steam practice ship, as has also been suggested, to steam in and out of port when the weather is pleasant, and to play at making sail when the wind is fair. From this he goes to a schooner-rigged steamship, or one with military masts, in the general service, where his instruction as an infantryman and marine artillerist is continued *ad infinitum.*

The difference between the man so trained and the deck-hand of a merchant steamer is one of degree only. Neither one is a sailor, nor possessed of the admirable characteristics of the sailor, while the sphere of action of both is confined to the deck. The trained man is, of course, the superior in general intelligence, orderly habits, discipline, and knowledge of arms; but he is not a sailor. And herein we find another of the many examples of history repeating itself; for we would, under such a system, have much the same general division of labor that prevailed on board the Roman war-galley; that is to say, the rowers who furnished the motive power of the galley would be represented by the engineer's force, and the *classarii milites*, or fighting men, would be represented by the marine artilleryman. There was a third class mentioned in the accounts of the Greek and Roman navies of the ancient civilization, but it seems to have excited little attention at the hands of the historian; this class was called *mariners.* They attended to the work about the vessel and had the care of such sails as were used.

It is generally conceded that if sails are to be abolished, sailors will no longer be needed. But *seamen the navy can never dispense with.*

If, on the other hand, sails are to be retained, then the sailor class must continue to exist; and it will be for the naval administrator to determine how best to shape the course of naval training so as to combine all the good qualities which have heretofore characterized the sailor, with those which go towards the "make-up" of the seaman-gunner. Now, have we advanced sufficiently far in our knowledge of steam and electricity to warrant dispensing with the wind as a motive power?

## SAILS.

The first essential in the discussion of questions affecting naval policy is to state the end proposed: whether we are always to act on the strictly defensive, or whether, in case of being forced into

war, we are to be prepared to assume the offensive whenever such a course seems wisest.

A naval policy is largely the result of racial characteristics. The instincts of one race may lead to one line of policy; those of another race to quite another line. Thus one race may be brave and chivalric and excel in individual genius, and yet have no aptitude for foreign trade, or taste for maritime affairs of any description. Having no love for the sea, they would keep within their own borders. "We are a self-supporting people," they would say; "why concern ourselves with ancient laws of exchange of commodities with the effete monarchies to the east and to the west of us? We are a law unto ourselves."

Under such a régime our national policy would scarcely reach beyond our own boundaries. Motives of economy, rather than public utility, would control the development of the navy, and defensive tactics govern its operations.

As the navy would be for harbor defense only, the original monitor type would serve the purpose. The coal-yard and the dry-dock would always be within easy reach, hence there would be no need of masts nor sails, nor yet sailors, nor would the vessel's bottom require copper-sheathing. The time of such vessels, when in commission, would be spent at a wharf, for convenience of landing the crew for infantry drill. Meanwhile our fisheries would die out, and the American flag would disappear from the seas.

Under the dominion of another race, one, let us say, with an hereditary genius for maritime affairs, a different policy would obtain. If, for example, the Anglo-Saxon race continues to shape the destinies of these United States, then it is probable that we shall see a gradual revival of American shipping, the relegation of our foreign trade to American bottoms, and a return to our former naval policy. For among the characteristics of the Anglo-Saxon race are to be noted successful enterprise in foreign trade and a love for the sea.

This is no place to discuss the relative merits of the two systems. Each one is consistent in its several parts, and has its claims to consideration. But a line of naval development should proceed on one theory or the other.

The naval policy entered upon shortly after the close of the war of 1812 was that of a maritime people noted for enterprise and sagacity in mercantile affairs. Our "white-winged" commerce spread over

the most distant seas, and thither our war-ships followed to give it moral and material support, whether the trader itself at sea, the merchant in a distant land, or our representatives accredited to foreign governments. Our ships, though few in number, were the best of their kind, and represented every class. We had fast frigates to overhaul merchantmen, and noble battle-ships that could stand up to any foreign battle-ships they were likely to fall in with abroad. The battle-ships were constructed on the theory, that while they furnished the best system for the outer line of coast defense, they could, if required, be sent on long cruises in distant seas. They were used as flag-ships on foreign stations, a certain number being held in reserve. They were "unwieldy" only in the imaginations of those who had never sailed in them.

A revival of our early naval policy would call for a battle-ship on each foreign station, with a proportionate number of cruisers in addition.

Formerly our ships were in a large measure self-sustaining. They are not so now. Having no outlying stations for coaling, docking, or repairing, and being entirely dependent on the good-will of those who, in a maritime war, might find it to their interests to throw impediments in the way of our receiving aid, the rig of our ships and the preservation of their bottoms from fouling become questions of the highest importance. As the character, moreover, of the average ship will qualify the character of the average crew, it is germane to our subject to bestow a passing glance on the rig of war-ships in general. This we may do without venturing to argue the questions involved.

According to the prevailing systems of naval tactics, the battle-ship finds her principal rôle in the line of battle. As her province is to fight in concert with other battle-ships, she should excel in manœuvring qualities, hence she is provided with twin screws. If, during battle, one screw becomes disabled, she is not thereby rendered helpless, for she can keep moving by means of the duplicate screw. To navigate under sail, she would require such enormous spread of canvas that, considering her peculiar character as a fighting machine, it has been thought better to give her none at all. Instead of sails, therefore, she is provided with two heavy upright spars called "military masts," from the tops of which sharpshooters, screened by steel shields, may fire down upon the decks of opposing battle-ships as they crash by each other in the shock of battle. The military mast will be also used as a place of observation during

battle. In the latest additions to the French ironclad navy they are so used. The French battle-ships Le Hoche and l'Amiral Baudin have on their military masts places especially designed for the commanding officer and the torpedo officer, from whence, overlooking the field of battle, they can direct the movements of their ship, distinguish in the mêlée friend from foe, and send out their torpedoes intelligently. Farragut first suggested and practiced this plan. The battle-ship, moreover, does not let go of her base of supplies, unless indeed she can fight her way to the enemy's coal-pile.

The rôle of the cruiser is altogether different. She has no place in the line of battle. Her manœuvring qualities need not be so great as to sacrifice for them certain other desirable qualities, hence she does not require twin screws. She will, as a rule, cruise singly, and fight single-handed, and, presumably, not at very short range. As a "commerce destroyer," which is, according to our authorities, the principal office of the steel cruiser, she will roam the seas in quest of prey, and remain out during long periods. She should therefore have full sail power, and her bottom should be protected from fouling. She severs herself completely from her base; hence the more self-supporting she can be made, the more efficient she will prove in war. If it is established, as now seems likely, that twin screws give better general results than single screws, then they should be made to uncouple.

The new steel cruiser is known familiarly as a *paper-sided* ship, to express the ease with which her sides may be penetrated and her vitals reached by guns of very small caliber, such as are assigned to secondary batteries. To give the "paper-sided" commerce-destroyer the characteristics of an armor-clad battle-ship proves one of two things: either that the prevailing systems of naval tactics are fundamentally wrong, or that—but this is wandering from our subject.

The first Naval Advisory Board, assembled under the Department's order of June 29, 1881, was composed of the best representative talent of the navy. Rear-Admiral John Rodgers, one of the most distinguished officers our navy has produced, was president of the Board. Chief Engineer B. F. Isherwood represented the Engineer Corps with marked ability, and John Lenthall, one of the ablest naval architects of his day in this or in any country, stood for the Corps of Naval Constructors. *The Board was unanimous in recommending single screws and full sail-power for cruisers.*

For convenience of reference we subjoin a table of sail areas, giving the proportion of sail spread by one of the old sailing ships, the Constellation; by the steam sloops-of-war, and by the steel cruisers, with a view to establishing a comparison between the several classes.

SAIL AREAS.

"As a rule, there should be given about 36 square feet of plain sail to every square foot of midship section."—(Theo. D. Wilson, Chief Constructor, U. S. Navy.)

"The Board is of the opinion that all classes [of ships recommended] should have full sail-power, the amount of sail surface not to be less than twenty-five times the area of the immersed midship section."—(Report of Advisory Board of June 29, 1881.)

"In place of the second-rate 14 knots vessels of the spar-deck type recommended by the majority, we propose to substitute ship-rigged first-rates of the single-deck type . . . of 4354 tons displacement and 20,000 square feet of sail surface."—(Minority report of Advisory Board of 1881.)

| | Area of Midship Section. | Area of Plain Sail. | Square Feet of Sail to 1 Foot of Midship Section. | |
|---|---|---|---|---|
| Constellation, | 545 | 18,000 | 33 | sailing ship. |
| Brooklyn, | 628 | 19,327 | 30.77 | wood, single screw. |
| Richmond, | 560 | 16,600 | 29.64 | " " |
| Lancaster, | 721 | 20,700 | 28.71 | " " |
| Hartford, | 641 | 17,877 | 27.90 | " " |
| Chicago, | 790.24 | 14,880 | 18.83 | steel, twin screws. |
| Petrel, | 289.5 | 4,850 | 16.78 | " single " |
| Boston and Atlanta, | 675 | 10,400 | 15.40 | " twin " |
| Newark, | 807.23 | 11,932 | 14.78 | " " " |
| Yorktown, | 435.3 | 6,352 | 14.58 | " " " |
| Baltimore and Charleston, | | 0.000 | 0 | military masts. |

From this table it appears that had the Chicago been sparred in accordance with the recommendations of the first Advisory Board, she would have had a spread of canvas equal to that which she now carries plus the amount carried by the Yorktown. Even then she would have been under-sparred.

The lessons furnished by the recent experiences of the Brooklyn, the Iroquois, and the Inman steamer City of Paris, should not be thrown away upon us. Let us take a glance at the performance of the former, premising that it was an exceptional year for trade winds, which were "conspicuous by their absence" both in the Pacific and

the Atlantic. Where the maximum strength of the trade winds should have been found, only light airs and calms prevailed. Furthermore, she fell in with bad weather immediately after starting on her homeward passage, and for eight days after sailing still had the coast of Japan in sight.

The Brooklyn, Captain Byron Wilson, having broken her shaft, left Nagasaki, Japan, on the 5th of September, 1888, under sail, reaching Honolulu, Sandwich Islands, distant 5000, in 40 days; from Honolulu to St. Thomas, W. I., distant 16,000, she made the run in 141 days; from St. Thomas to New York, distant 1700, in 17 days; arriving in New York April 25th, having spent 198 days at sea in traversing 22,700 miles. She passed 33 days in port, viz. 26 days in Honolulu and 7 days at St. Thomas. While rounding the Horn, under whole topsails and topgallant-sails, there was a period of two weeks during which she averaged 200 miles a day. It is proper to state here that her propeller had been hoisted in on deck, and the aperture between the stern-posts planked up, giving her a run as clean as that of a sailing ship. This was an altogether exceptional advantage.

The steel cruisers have twin screws, which reduces the chances of similar accidents; for with one screw disabled they can steam very well with the other. Their use obviates, moreover (at least so it is claimed), the necessity of sails.

Let us now place the Baltimore at Nagasaki with one screw disabled and no sails, and ask to which ship one would confide his fortunes in a passage to Honolulu of 5000 miles: the Brooklyn or the Baltimore? The old or the new? The former, though dull, can sail, and could manage to fetch some place, let the winds be never so adverse. The Baltimore also may manage to get in somewhere. But if her one screw, doing double duty, *should* break down in mid-ocean, the ship would be rendered absolutely helpless. She could do nothing.* Speaking for ourselves alone, we would prefer to take our chances in the old Brooklyn.

* The following notice, taken from a recent paper, is slightly suggestive of the condition of a sailless cruiser on breaking down in mid-ocean: "Halifax, April 4th, 1890. Captain Hire, of the brigantine Alejo I. from Barbadoes, reports that on Monday last, while south of the Georges, he sighted a steamer flying the signals, '*Want immediate assistance.*' '*Starving.*' He bore down for her, and found her to be the steamer Southgate, from Placentia, N. F., for New York. Her shaft was broken and her provisions nearly all gone. She had been in a helpless condition for a number of days, *not having sufficient sails with which to make headway.*"

What if the accident to the City of Paris had occurred when only half-way across?

To provide for such a contingency as the disabling of the motive power, though one of the conditions of the problem we are called upon to solve, is not the most important one. The main question is one of logistics, and as such is to be dealt with by the naval strategist and tactician. In the case under consideration the great desideratum is the coal supply, or, what amounts to the same thing, the husbanding of that already on hand for the hour of need.* The steel cruiser, with fine lines, twin screws, triple expansion engines in separate water-tight compartments, and great coal capacity, renders possible long passages at sea under steam. For, with increased speed, we now have comparatively less expenditure of coal. This leaves little to be desired if eternal peace could be assured. But the naval tactician demands that there shall be a still greater saving of coal, a still greater economy of the vital principle to which he owes his very existence on the field of active operations in war.

The transatlantic steamer, with a fixed route and short stoppages, may make the round trip without coaling away from a home port; and the English ship-of-war is pretty sure to find an English coal depot in almost any part of the world. With the United States the case is different. Having no coal depots beyond our own ports, we must calculate upon a cruiser carrying fuel enough during peace for long passages, with a liberal margin for such contingencies as are likely to arise at sea—bad weather, delays, casualties, etc. During a maritime war, when coal may be reasonably refused by neutrals, the difficulty of obtaining supplies abroad would be greatly aggravated, hence the necessity of greatly increased coal endurance, beyond that already given.

As a "commerce destroyer," the steel cruiser would have to remain out for long periods, watching for her prey and chasing suspicious craft. Stationed on one of the great highways of ocean commerce, she would lie in wait for traders, who would be warned of her presence and give her a wide berth. She would have to seek them. Under similar conditions, a cruiser with full sail-power could reach her destination with her bunkers full of coal, and in many cases could do a great deal of cruising under sail, thereby holding on to her coal for battle or for chase. The underlying principle is that logistics should conform to strategy, not strategy to logistics.

* *Logistics* is the branch of the military art which has to do with the details of moving and supplying armies or fleets. The logistics of this case is the coal supply, which is of the very first importance. Under certain conditions coal may rank above ammunition in the scale of military values.

The Newark carries 850 tons of coal. Should disturbances in Rio place in jeopardy the interests of American citizens engaged in business in Brazil, it might be desirable to send her there. She could steam the entire distance, 4733 miles, in twenty days at her most economical rate, 10 knots per hour, with an expenditure of 500 tons of coal, or say 25 tons per day.

The Brooklyn, with her propeller in place, could make the passage under sail. It would take her three times as long, perhaps, but she would arrive at her destination with a comparatively small expenditure of coal.

After being in Rio for some time, the coal question forces itself, let us suppose, upon the attention of the captain of the Newark. Distilling and cooking and running the dynamo must go on, and the coal supply gradually but surely melts away. Strained relations with the authorities on shore render it impossible to get coal there; and as the Riachuelo is close at hand, the American admiral is loath to let the Newark go. But go she must, there is no help for it, however urgent the necessity for her presence, for she must have coal at any cost. So with due regard to the margin of safety, there comes a a day when she must steam down to Monte Video, 1200 miles further south, to fill up her bunkers.

The Newark is no sooner at sea than it is discovered that her speed has been diminished fully 25 per cent, owing to a foul bottom. Under such conditions the Riachuelo, with her clean copper-sheathed bottom, could easily overhaul her in the event of actual hostilities. Knowing this fatal weakness of our cruisers, it would be strange indeed if the authorities on shore did not resort to those dilatory tactics by which negotiations would be prolonged and a rupture forced only after coal and patience had been exhausted.

Let us suppose a similar case in the Pacific, where the necessity might arise for sending the Charleston, with her two military masts, to Valparaiso, a distance of about 5000 miles. The Charleston's coal capacity is 800 tons, giving her a steaming radius of 6450 miles at 10 knots an hour. The passage at the most economical rate of speed would require 650 tons of coal, leaving but 150 tons for "coal protection" in the event of a battle. The Hartford could have made the passage under sail.

Or, let us place the Charleston at Honolulu, and require her to go thence to Valparaiso. The distance is say 5900 miles, approaching the limit of her steaming radius. On reaching Valparaiso, coal becomes an

absolute necessity. There is plenty of it on shore, but, unfortunately, the Blanco Encalada, an armor-clad, copper-sheathed vessel of war, lies between the Charleston and the coal-pile, and the gravity of the questions at issue between Chili and the United States forbids the former giving supplies to a possible enemy. The Hartford could have made the run under canvas, and reached her destination with enough coal for emergencies.

Let it not be supposed that we advocate a return to the Brooklyn class. That class is cited merely to show that we have, in times past, built steam cruisers that would do well under canvas, and thereby enabled to husband their coal supply for emergencies. Our contention is that the steel cruiser should be able to do the same. And it certainly seems only reasonable to ask that the cruiser of our future navy should be furnished with the means of reaching a distant point where belligerent operations may ensue, with her bunkers practically full, for two reasons: first, that she may be prepared for battle, chase, or a protracted blockade; and, secondly, that her full bunkers may afford the coal protection they were designed for. Full sail-power would furnish the means. We are not wholly ignorant of the objections urged against putting masts and yards on modern cruisers. But if the naval tactician declares that the cruiser must have full sail-power, we venture to assert that the naval architect will be able to overcome the objections and solve the problem.

If the naval architect declares that the combining of all the essential features of a fast steam cruiser with efficiency under sail is not an insoluble problem, then the naval tactician would be enabled to avail himself of one of nature's most potent forces, the ceaseless winds, while he held his principal motive power in reserve for the day of battle. His position might then be likened to that of the general of an army who should hoard his own supplies while living on the enemy. The architect having so decided and furnished a sail plan, the seaman then steps in to arrange the details, so that a large spread of canvas may be rapidly reduced, and sails and spars so disposed of as to present the minimum of resistance when steaming head to wind.

So far, our highest authorities (those already quoted) have declared for full sail-power, and such we believe will be the final verdict for war-ships designed for service in distant seas. As a corollary to the proposition of full sail-power comes the demand for copper-sheathing on the bottom of our cruisers. As those already

built have neither, it is very evident they are not intended for foreign service during war.

The question of copper-sheathing has been so thoroughly discussed by Mr. Philip Hichborn, U. S. Navy, in his exhaustive article on "Sheathed or Unsheathed Ships,"* and by Lieut. S. Schroeder, U. S. N., in "The Preservation of Iron Ships' Bottoms,"† that there is little if anything left to be said on the subject. It is only referred to here as belonging to the "tactics of the ship," which has to do with the question of the training of the personnel of the ship.

The history of the Civil War furnishes a practical illustration of the soundness of our views on the question of sails. Captain Raphael Semmes, of the Alabama, writes:‡ "I was much gratified to find that my new ship (the Alabama) proved to be a good sailer under canvas. This quality was of inestimable advantage to me, as it enabled me to do most of my work under sail. She carried but an eighteen days' supply of fuel; and if I had been obliged, because of her dull sailing qualities, to chase everything under steam, the reader can see how I should have been hampered in my movements. I should have been half my time running into port for fuel. This would have disclosed my whereabouts so frequently to the enemy that I should have been constantly in danger of capture; whereas I could now stretch into the most distant seas and chase, capture, and destroy, perfectly independent of steam. I adopted the plan, therefore, of working under sail, in the very beginning of my cruise, and practiced it unto the end. With the exception of half a dozen prizes, all my captures were made with my screw hoisted and my ship under sail; and, with but one exception, . . . I never had occasion to use steam to escape from an enemy."

In another place he says: "She (the Alabama) was a perfect steamer and a perfect sailing ship at the same time." Her propeller was constructed to hoist clear of the water. The reverse of this picture is also shown: "The reader has seen that the Sumter, when her fuel was exhausted, was little better than a log on the water, because of her inability to hoist her propeller." Will the steel cruiser do any better at sea "when her fuel is exhausted"? The Sumter had a good supply of sail and one screw to drag; the steel cruiser has no sail and two screws to drag.

* Vol. XV, No. 1, 1889, Proceedings U. S. N. Institute.
† General Information Series, No. VII, 1888.
‡ Memoirs of Service Afloat.

## THE TRAINING SQUADRON.

Assuming that the naval strategist will decide that, whatever practice may obtain abroad, the naval policy of the United States requires a full-rigged, copper-sheathed steam cruiser of high speed, then the demand for sailors will continue. It was to supply that demand that the Training Squadron was put in operation in 1881 (see General Order No. 271 of 1881).

The first essential in organizing a system of training is to know exactly what is to be produced. "Going into training" means the preparing of the brain, the nerves, and the muscles for the accomplishment of a certain specified end, whether it be for championship in the ring, success in the boat-race, or generally for success in any undertaking requiring strength and skill. Mental stimulus is necessary to complete muscular development. It matters not what may be the exciting cause—whether ambition, the pursuit of pleasure, or the necessity of providing one's daily bread—the result is much the same. A boy gladly expends in a game of baseball as much heat and energy as would be required to saw a cord of wood; the latter would disgust him. Men whose sole object is the increase of muscle tissue soon turn with loathing from the tread-mill system of the gymnasium; adequate mental stimulus is wanting.

The object of naval training such as we are now to consider is to produce a man who, to the fine qualities of the sailor as we have endeavored to portray them, adds skill in the use of the high-power guns of the present day. That is the object of our naval training system as we understand it. It is to produce men like those who handled the lock-strings of our 9 and 11-inch guns and Parrott rifles during the late Civil War—prime seamen, cool in the face of danger, courageous, and, withal, capital shots—men like the one who fired the Cumberland's last gun.

It is important that we should have armorers in the navy, and gunsmiths, and bookbinders and typesetters and the rest. But, before all else, we must have seamen and good gun-captains, with an abundant surplus of those who are to fill their places when they fall in battle. In other words, our guns' crews are to be made up of trained men. The highest expression of the trained man is to be found in the able seaman and expert gunner combined. It was for him that the rating of *seaman-gunner* was established. It was expected that seaman-gunners would be assigned as gun-captains of the guns of our primary batteries, and that in time every gun

afloat would have a seaman-gunner for its captain. It was with that view that a school of practical gunnery was established on board the Minnesota in 1881 and General Order No. 272 of that year issued. The plan failed then through causes not necessary to specify, only to be renewed now under conditions likely to ensure its permanency. We may therefore safely assume that a gunnery-ship will hereafter form part of our naval training system, and that the seaman-gunner will no longer be degraded by assigning him to such duties as ship's lamplighter, typesetter and the like.

One of the most important truths to be understood by those having to do with naval training is, that unless pupils under training are early habituated to life on the water, much of the time, labor, and expense devoted to the work will be thrown away. Why train the naval apprentice for civil life?

It should be made an offense for any officer to moor a school-ship, or a training ship, or any vessel used for the education of young seamen, to a wharf or dock unless actually necessary when the vessel is under repairs. Under the specious plea of convenience of landing for infantry drill, the pernicious system of tying up the school-ship to a dock has wrought its full measure of evil upon the service. It is to be hoped, in the interests of the profession, that the practice is now at an end forever. Let the young sailor understand from the beginning that his only way of getting from his ship to the shore is by means of a boat, and let the boat and its management become thoroughly familiar to him, from the very outset of his career.

Infantry drill necessarily forms a part of the programme of exercises of the stationary school-ship; but it is just as necessary that the apprentice should learn how to get into a boat with his arms and accoutrements on, as it is that he should learn to march with them on. The few months spent on board the stationary school-ship are devoted to the "breaking in" process, to prepare the apprentice for the next stage of development, the sea-going training ship. With that view he is taught to take care of himself and his belongings, taught to keep his person and his clothes and bedding clean and in good order, to conform his words and deeds to the rules of the ship. In short, he is given his first lessons in naval discipline, which, if looked into, will be found to mean a great deal of self-discipline. We cannot begin too early with that.

English grammar, and arithmetic, and geography, and infantry drill are excellent subjects for the occupation of the mind of the young

seaman; but there is an occult process of absorption going on without cessation, by which the mind of the naval apprentice becomes embued with a taste for the service which ends only with life itself. That part of the education is worth all the rest put together; it cannot be imparted, it comes of itself to the boy who is endowed by nature with an aptitude for the sea. He soon finds himself in perfect correspondence with his environment; the ship itself and all it contains; the sailors and their peculiarities; the guns and arms, suggestive of battle; the system by which the crowded decks seem never in confusion; nay even the very smell peculiar to ships. All at first have a fascination for him, and then become a part of his life. Thus he acquires from the very beginning something of the ways of sailors, their modes of expression, habits of thought, manners, customs—the first insight into the *technique* of his calling. He also learns their stories, their songs, and their traditions. The attraction of his surroundings *draws out* his powers. The inward being is in sympathy with the external life. *He is in correspondence with his environment.* This is education; it comes not of books. *Educare* means to "draw out," not to "put in" or cram.

There are, it is true, boys who, having no aptitude for sea life, find all this positively distasteful. When this is due to racial characteristics, or, what amounts to the same thing, the law of heredity, it is difficult to overcome. But as it is very common to find among boys cases of retarded development, both mental and physical, we should not, in the earlier stages of training, be hasty in determining a boy's fitness for the service.

The routine of drills and exercises on board the stationary school-ship prepares the boys for the next step in the process—the cruising ship. The readiness with which the boy falls into place on board the latter is the measure of the success of the former.

It must be confessed that officers are sometimes unreasonable in asking too much of the boy who has been but six months on board the school-ship. They expect him to take the wheel, or heave the lead, or run up aloft like an able seaman. But the school-ship does its part if it gives the apprentice a good grounding in the merest rudiments of his calling.

It is to the cruising ship, however, that we must look for the most important results, for it is here that the apprentice is expected to discover if he is made of the right sort of stuff. The cruises of the training ships should always be to foreign ports. We want blue-water

sailors, and they can be made on blue water only. Hanging around the coasts and inland waters and anchoring every evening or two, so that all hands may enjoy a night in, is very pleasant but it is not business. The argument in favor of home waters is that by being frequently at anchor the boys may be taught more. If that means that they can be taught more out of books, it is probably true. But we have started out with the distinct understanding that the object of the training ship is to produce sailors—deep-water sailors; and the only way to do that is to make deep-water cruises. The young sailor may then gain that experience at sea which goes so far toward forming his character. No artificial method can take the place of actual experience at sea. The West Indies furnishes an admirable cruising ground for training ships, particularly during the winter months.

By letting the ships cruise singly, with a view to their meeting at a certain time, under squadron organization, for competitive exercises, preceding the annual examination and dispersion of the advanced classes, the very best results follow. The spirit of rivalry stimulates each one to do his best.

Each ship's company of boys should be divided into two classes. At the end of the winter's cruise the advanced class only should be transferred to the general service, leaving the remainder to take another cruise, the complement being filled up from the stationary schoolship. This ensures having always a fair proportion of the boys who are familiar with the ship. The second class of one cruise becomes the first class of the cruise following.

The permanent crew of the practice ship (the petty officers and seamen) should be carefully selected from general service men. It is from them that the boys get their earliest and most lasting impressions. The longer the boy can be kept on board the sailing practice ship, provided she be kept cruising, the better.

The fact must not be lost sight of that the practice ships, though intended primarily for the training of the naval apprentice, are at the same time an admirable school of practical seamanship for the young officers who go out in them.

It has been objected that service on board an obsolete sailing ship is no preparation for duty on board a modern steam cruiser. This is a great mistake. The handling of a sailing ship at sea, under all the varying conditions of wind and weather, stimulates the faculties as no other experience can.

The broadsword and the rapier (or foil), as weapons, are obsolete, and yet constant and intelligent practice with them, and with the "gloves," trains one into better command of the temper and of the limbs. Such exercise, properly conducted, gives a quick eye, a good wind, and an active liver, and enables one to keep cool and self-possessed in the presence of a certain class of dangers. The weapons themselves are not subsequently brought into requisition, they are simply used as a means to an ulterior end. It is the same with the sailing ship. Service in one teaches an officer what he cannot so readily learn on board a steamer. Among other things it teaches him to control men.

Of two officers, in other respects equal, that one will make the best steamer officer who has had the most experience in sailing ships.

From the training squadron the apprentice is transferred to the general service, where he remains till he comes of age.

It is much to be regretted that a more uniform system of treatment could not be accorded the apprentice in the service at large. Perhaps such a thing is too much to ask of human nature.

During one period it was the practice, when a ship was paid off, after a cruise, to give the apprentices a leave of a month or so, with orders to report on the termination of their leaves on board the Minnesota, where they were to serve out their unexpired terms. This gave a good opportunity to judge how the boys had been cared for by the officers during the cruise. The greatest difference was observable in the apprentices from different ships. One set of young men (for such was the rapidity of physical development that the majority presented anything but a boyish appearance) would have plenty of money due them, each a complete outfit of clothing, clean and in good order; be manly in bearing, respectful in demeanor, and thoroughly well up in the details of their duties, whether aloft or at the guns. Of such a set, nearly all would be as far advanced in rating as the regulations would permit. Another draft of apprentices, who had returned in another ship, would be the reverse of all this. It is scarcely necessary to add that the former set would, as a rule, express a partiality for the service, while the latter would not. The differences were so marked, it was suggested that on a ship being inspected at the expiration of her commission, a special report should be made of the apprentices and the progress they had made during the cruise.

This is a very important phase of the subject, and has a direct

bearing on the question, Will the apprentice, after attaining his majority, re-enlist for the general service?

It is for the apprentice who, on his discharge, re-enlists within a stated interval that the gunnery-ship is intended. Here he goes through a course in practical gunnery and cognate branches, is instructed in practical electrical work and torpedo service, and qualifies for the rating of seaman-gunner. The course on board the gunnery-ship will probably include instruction with the diving apparatus. This completes the system of special training.

### WAR PROBLEMS.

We have spoken of a Training Squadron: there are two of them; one for boys, the other for officers, seamen and marines. The latter is composed of the ships of the North Atlantic Station. That is the high school, so to speak, of our naval training. Assembled annually for exercises on an extended scale, it becomes the best school of application we could have. Acting in conjunction with the War College, the operations of the squadron occupy at once the highest plane attainable during a time of peace. The following plan of operations has been attended with success:

Two or three representative officers of the squadron meet a like number of officers of the college, the whole occupying the position of a general staff to the commander-in-chief. The latter indicates the broad lines of operations to be undertaken, the staff arranging the details. If the commander-in-chief decides, for example, to attempt to force an entrance into Narragansett Bay, the attack and defense will be arranged with that view. If it be to attack New York by entering Long Island Sound at its eastern end, then the defense may be designed to prevent his passing the Race or getting by Plum Island; or the problem may be to effect a landing on Long Island, and to oppose such landing.

Whatever the military and naval problem may be, it is carefully worked out in detail by the staff, and maps and written instructions prepared for the information and guidance of the principal officers in the same manner as if it were an operation in war. When this has been done, the officers are assembled and the entire plan is explained by one of the staff. The object is generally to illustrate some military principle or to execute some strategic movement, or perhaps to show the practical working of some tactical manœuvre.

At this meeting it is expected that every officer, particularly such as are entrusted with important commands, will interrogate the lecturer until the part each one has to perform is thoroughly understood. Umpires are appointed who are to take notes as to the carrying out of the plan in practice. At the appointed time the projected movements are carried out as nearly according to the programme as possible. In due season, after the conclusion of the operations, the officers are again assembled and the criticisms of the umpires read. A general discussion then takes place. By this intelligent method of conducting exercises, officers and men are brought to a realizing sense of what hostile operations might lead to, and, next to war itself, learn from them more of their business than they possibly can by any other method. Not only are such exercises highly instructive, but they lend a pleasing variety to the monotony of a cruise, and interest, in an unusual degree, all who take part in them. They are to be commended, if only on hygienic principles.

In addition to the war problems, there may be projected a number of exercises in which all the ships of the squadron take part; such as distant expeditions in boats necessitating an absence of four or five days, encampments on shore of a week's duration, night attacks by the boats or the ships, etc., etc.

## RESERVES.

If a settled policy calls for a small navy, it should also call for a large reserve of force, wherewith to expand that navy in time of need. The fisheries and the mercantile marine generally supply the reserve. As early as 1778, it was declared in Congress that "the fisheries of Newfoundland were justly considered the basis of a good marine." The great benefit of having such a class of hardy seamen to draw upon was felt in the war of 1812; and in 1813 Congress passed the act granting a bounty to fishermen engaged in the bank (Newfoundland) and other cod fisheries, with a view to encouraging that industry and nursery of seamen. The act of July 28, 1866, however, abolished the granting of bounties. The greatest number of seamen in former years were produced in the sailing ships engaged in foreign trade. That source has almost ceased to exist—almost, but not entirely. In some lines of trade, sailing ships are still profitable. As long as they exist, Congress should oblige or induce the masters or owners, by bounty or otherwise, to take boys out in numbers proportioned

to the ship's tonnage.* By this means our merchant vessels will be training up seamen that would be a very material aid in manning our ships in time of war. Fifty years ago it was estimated that about ninety thousand seamen were engaged in our foreign and coasting trades and fisheries. It was further estimated that of that number, owing to the interruptions of trade by a maritime war, about thirty thousand would be available for the navy. How many seamen could we count upon to-day?

## THE YACHT SERVICE.

When vessels of war were built of wood, the gun was required to send a projectile through about 30 inches of tough live oak. As a consequence, guns of heavy caliber were in demand. In the war of 1812, much of our success was due to the fact of having guns of larger caliber than our opponents. From that day the caliber of guns increased till it got up to our IX and XI-inch smooth-bore guns of the Dahlgren pattern. Small vessels, or such as had light scantling, could not carry these guns, and small smooth-bore guns were of little use. But owing to the great changes brought about in late years, a moderate-sized yacht can carry a gun that could place the thin-sided Chicago, of 4000 tons, *hors de combat* at a distance of a mile and a quarter. The Hotchkiss 9-pounder, or the 6 or even the 3-pounder, which could be carried by many of our yachts, will penetrate the side of the new steel cruiser at 2250 yards, and a chance shot might reach her boilers. Some of our steam yachts could do better. The 4-inch breech-loading rifle, weighing 3200 pounds, throwing a 30-pound projectile, will penetrate 6 5 inches of iron at 1000 yards. This gun mounted on a pivot, on board a fast steam yacht, would prove very effective.

It may be seen from these changes in the character of the offensive and defensive powers of war vessels how a flotilla of steam yachts might thus be made a valuable auxiliary to a fleet of battle-

*All foreign-going sailing ships should take out, as part of their crews, boys who are not able seamen, to do nautical duty, as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vessels from | 100 | to | 300 | tons, | at least | 2 | boys. |
| " | " | 300 | " | 500 | " | " | 4 | " |
| " | " | 500 | " | 700 | " | " | 6 | " |
| " | " | 700 | " | 1000 | " | " | 8 | " |
| " | " | 1000 | " | 1400 | " | " | 10 | " |
| " | " | 1400 | and over, | | | " | 12 | " |

ships, assigned to the duty of guarding our coasts in time of war, as ocean scouts, despatch vessels, or for torpedo service.

Statistics show that the majority of the crews of our yachts are of Scandinavian origin; they come of a great race of seamen.

"When the Romans invaded Britain, the Brits had no fleet to oppose them. We do not, until a later period, meet with that love of the sea which is so characteristically English; not before the gradual absorption of the earlier inhabitants by a blue-eyed and yellow-haired seafaring people, who succeeded in planting themselves and their language in the country."

"To the numerous warlike and ocean-loving tribes of the north, the ancestors of the English-speaking people, we must look for the transformation that took place in Britain. In their descendants we recognize to this day many of the very same traits of character which these old Northmen possessed."

"Britain finally became the most powerful colony of the northern tribes. At last the land of the emigrants waxed more powerful than the mother-country, and asserted her independence; and to-day the people of England, as they look over the broad Atlantic, may discern a similar process taking place in the New World."—DU CHAILLU, *The Viking Age*.

If, with due respect to the distinguished author, instead of "emigrants" in the last clause of the above quotation, we should read *conquerors*, the statement would be nearer to historical truth; and nearer still if it be made to refer to an earlier period of our own history rather than "to-day." The passage is transcribed for the reason that it gives a picturesque view of the influence of race upon the progress and direction of national development. The lesson is full of meaning to us. It is for the naval administrator to trace along the streams of immigration the strain of a race whose "school of war was on the sea"; it is for him to ascertain to what extent it exists in this country now, and how far it may be made available in the event of war.

Boys of a sea-loving race will naturally seek the sea; it is the part of wisdom, therefore, for the Government to make the paths straight which lead to the gratification of those tastes, that the training of young seamen may be carried on unceasingly, and to a far greater extent than will ever be possible, even in a navy many times greater than our own. Indeed, from motives of the highest patriotism, as well as from professional considerations, the naval administrator is

directly concerned in what is popularly termed the rehabilitation of our mercantile marine; he is interested in the establishment of an executive department of the Government having for its object the promotion of ocean traffic, and the supervision of all public business relating to the same; in the building of merchant sailing ships and fast steamers; in the registration of merchant seamen, and, in general, in whatever tends to foster and increase foreign commerce under the American flag.

Senate bill 1628, reported January 6, 1890, for the "encouragement of commerce, the protection of navigation, and the improvement of the merchant marine in the foreign trade," proposes a measure of great national importance and of incalculable benefit to the navy.

A broad and comprehensive scheme for giving the utmost freedom of scope to our maritime interests is, indeed, but part of the policy of keeping the navy down to the merest nucleus of a floating force.

## DISCUSSION.

### NEWPORT BRANCH.

NEWPORT, R. I., *June* 26, 1890.

The meeting was called to order by Rear-Admiral Luce, President of the Institute, and the members were requested to nominate those they desired to fill the offices of the Branch, which resulted in the election of Commander T. F. Jewell as Vice-President and Professor Charles E. Munroe as Corresponding Secretary.

Commander Jewell was then called to the chair and made the following opening remarks:

*Gentlemen*:—We have assembled this evening for the purpose of discussing a paper on "Naval Training," a subject of vital importance to the service in these days when new appliances and new methods are replacing the old. We are fortunate in having with us the distinguished author of the paper, an officer whose experience in the service comprises nearly half a century, who has ever been foremost in advancing the interests of the Navy, whether it be in the training of men, the education of officers, the discussion of the type of vessels-of-war, or the methods of handling them; and who, although he has passed the period of his active service in the Navy, is still as alive to its needs and interests as any of those present. He kindly offers to give us a résumé of his paper, and I now have the pleasure of introducing Admiral Luce.

Rear-Admiral LUCE, U. S. N.—*Mr. President and Gentlemen*:—As some of those present may not have seen the paper about to be discussed, or may not have had time to read it, a few explanatory remarks may not be out of place.

I am glad to notice among those present a member of the medical profession, for one of the principal questions under consideration touches upon matters in which they are directly concerned. The first question, briefly stated, is, "How far has the introduction of steam, as a motor power, modified the character of the sailor?"

That is the first question treated of in a general sort of way by the paper. Or, to put it in another form and judging from current events, "How far *will* the character of the sailor be modified by the exclusive use of steam as a motor power?"

The sailor exists under two characters. First, in the popular estimation, which pictures him as a man given over to drunkenness and debauchery, and addicted to profanity. The second is his real character, given by those who best know him: owning all the weaknesses of humanity, indeed, in common with all men, but possessed, more than is common, of certain qualifications which are the product of his arduous life—such as physical courage, muscular power, self-reliance and endurance—qualifications of the highest value in war, for that is, after all, what everything about us means—war, or the preparation for war. Now, it is owing to the very fact that sailors have such a superabundance of physical force—such an excess of vitality—that, when released from the restraints of discipline, those forces seek a vent; and when the controlling influence of a strong will becomes clouded by drink, riotous conduct is generally the result. But it is a base aspersion on the class to say that sailors, as a rule, are given to intemperance. My own experience goes to show that such is very far from being the case. What are called North country sailors are noted for their sobriety; and there are many like them.

Now, admitting that the exclusive use of steam has a tendency, and a very decided one, to change the physical and moral qualities of the sailor, the next question is, "Is it possible to devise a system of training, by means of which all the good qualities ascribed to the sailor of the past may be preserved and all the objectionable ones eliminated?" For my part, I believe it is not only possible, but I believe we are doing it now. I have great faith in our naval training system. It has its "ups" and its "downs," of course, in common with the rest of the world. With the exception of an occasional set-back, I believe the progress made by our system of naval training has been fair. If there be any fault to find, it is due to our peculiar system of naval administration, and not to a want of personal interest in the apprentice system. To avoid the chance of being considered "personal" in anything I may say, it may be as well to state that no reference is made to the present time or to the present administration, but rather to an indefinite period in the past.

With the idea of beginning a course of training which was, in the end, to produce a man-of-wars-man, an effort was made some time ago to cultivate in the young apprentice a fondness for the water. With that view the New Hampshire's boats were to be seen every afternoon under sail and filled

with boys. Boat sailing was a recreation the boys looked forward to on Saturdays with great pleasure. But far better than the boats was the schooner Wave. The best boys were selected for her crew, and, when she went out, one boy was placed at the wheel, and another at the lead, the others alternating with them. In this way, under the guise of recreation, the greenest boys were enabled to pick up something of sailorizing; but the important part of it was that any taste they might have for the water was brought out by this species of amusement. Going out in the Wave and in the cutters, under sail, was held out as a reward to the boys for good behavior. Besides the schooner Wave there was a large working model of a full-rigged brig, built up on the New Hampshire's first launch. By the use of that model the boys were enabled to learn the names and the lead of all the rigging, instead of getting it by heart out of a book. In the little brig they had all the spars and sails and rigging of such a ship as the Boston, so that the boys not only saw the lead of the ropes, but the effect of hauling on them, the manner of making and taking in sail, etc., etc.; in short, it was such a working model as enabled the instructors to take the boys through all that branch of practical seamanship in an intelligent manner, by object-lessons. The dismantled hulks of the Wave and the little brig now lie in the cove at the training station in an advanced state of decay, and scarcely ever does one see a boat belonging to the training squadron under sail. Base-ball and field sports generally completely usurped the place of sailing and fishing parties.

Now, it may be said in answer to all this that boat sailing is out of date; that the steam launch has rendered sails for man-of-war boats unnecessary. But it sometimes occurs that a ship-of-war has but one steam launch, and that it may be necessary to send out several boats at the same time, and not all of them in the same direction. Moreover, it may, and sometimes does, occur that the distances the boats may have to go are great. Let it be supposed that a boat expedition has to be sent out with the prospect of a week's absence from the ship. In that case the boats must be self-reliant. For such contingencies our boats should be constructed and rigged with a special view to carrying capacity and for sailing, and our boats' crews should be good boat sailors. I have seen our training cruisers come in here and their boats constantly go to and from the shore under oars when they had a fair wind and could sail. I may say that such is the rule. I will go further and say such is the rule not only on board our training ships, but on board our ships generally throughout the service. Furthermore, the very reverse of this is the rule on board of foreign ships-of-war.

It will be observed that when foreign ships-of-war arrive here their boats will, as a rule, go to and from the shore under sail whenever the wind permits. It is so all over the world. I have often and often seen foreign ships-of-war, particularly the English and French, send their boats on shore in bad weather, with their sails reefed down, when we did not dare to lower our boats.

It may and probably will be answered that, in this age of progress, with steam, electricity and big guns and torpedoes and the rest, boat sailing is a very insignificant affair, and really beneath the notice of men of science. That

may be true. But a taste and an aptitude for boat sailing are indications—simply *indications*, but altogether wanting with us—of a taste and capacity for sailorizing in general, if the word "sailorizing" may be permitted. Boat sailing is alluded to here, I may say by way of apology, because it belongs to the alphabet—the *alpha beta* of naval training, which is the subject under discussion.

It is commonly said that our earlier impressions are the more lasting. Now, the first and earliest impressions of the naval apprentice are all connected with fresh milk and green grass, with base-ball and foot-ball. He sees the officers deeply interested in homing-pigeons, and expending their energies on lawn tennis, while their principal instructors—the school-masters—as soon as the toils of the day are done, seek their homes on bicycles. Now, there is something commendable in training carrier pigeons, especially for war purposes, and bicycles are fast becoming a military necessity; but to familiarize naval apprentices, to whom we are to look as the forming of the very bone and sinew of the Navy, with such matters, can only result in one way, and that is to unfit them for life on board ship. As a question of naval training, then, we may reduce the proposition to its simplest terms, and ask the direct question, Which is better as a recreation for the naval apprentice, base-ball or boat sailing? One cultivates muscle, lungs and liver, it is true; but the other cultivates a taste which it is desirable above all things to cultivate—a taste for a life on the water; and the cultivating of the physical powers will come in the natural order of events on board the training cruiser. One encourages a taste for the land, the other for the sea. Now, we have plenty of landsmen in this country, but we have very few sailors; and we need to begin in early youth to cultivate them. Let us remember that it is necessary not only to train young men for the Navy, but to induce them to stay in the service after they are trained.

The subject of recreation has been dwelt upon because I hold it to be a very important factor in education. Boys from agricultural districts who love country life find ship life intolerable. They may be attracted for awhile by the novelty of the change, but as soon as that wears off they become unhappy, and, failing to procure a discharge, they will desert. The same may be predicated of the city boy who loves city life.

On the other hand, there are boys, whether from the rural districts or the city, who have a natural taste for the sea. Between these two lies a third class, who evince no decided partiality for one or the other—for the land or the water—but who very naturally will be attracted by what they find most pleasant.

As many of the boys who enter the service do not know their own minds, do not know what their tastes are, do not suspect what is in them, it is manifestly impossible for the closest reader of character to discover their aptitude for the service. Time alone can unfold their characters, their proclivities and their abilities. Taking the average boy, therefore, with a very dim perception of the possibilities within him, and knowing perfectly well that to fit him for ship life is one of the conditions of the problem of naval training, it seems to be the dictate of reason that the process of weaning the "raw recruit" from the

land and fostering a preference for the water cannot begin too soon. Hence "sailorizing" and aquatic sports should have the preference on board the stationary school-ship over soldiering and field sports.

The result of my observation is that the officers of the training station have done the very best possible with the means furnished them. If the proper tools have been withheld, they cannot be justly blamed for indifferent work.

One word as to the New Hampshire. She was brought here in 1881 and moored in the stream with four line-of-battle-ship's anchors and 90 fathoms on each chain. It was intended that she should remain there permanently, but, owing to a misapprehension on the part of those concerned, she was unmoored and hauled in the mud on the south end of Coasters' Harbor Island. It was a mistake; but the mistake will prove a fortunate one if it has taught us the evil effects of too close a connection between the school-ship and the shore.

Surgeon J. C. Wise, U. S. N.—It has been said that, after all, the greatest wealth of a nation consists in the possession of a vigorous population, and that it cannot be maintained that money is the sinews of war, if the sinews of men's arms are failing (Lord Bacon).

Able military critics assert that high courage is the concomitant of bodily soundness, and that the power of armies is dependent upon the capabilities of the individual soldier. Comparative study justifies the statement that the strongest animal is the most enterprising and courageous.

Of all the factors entering into the acquirement and maintenance of manly strength and development, that of occupation is second to no other in importance, carrying with it another equally so—that of nutrition, man's occupation having direct relation to his ability to procure his food supply.

The results of occupation as affecting growth and development have been recently illustrated by Mr. Walter Galtho, in a study of "The Physique of European Armies." It appears from the writer that one of the effects of the operation of the corn laws in England has been to increase the urban population at the expense of the rural districts, which has had a very depreciating influence on the recruiting material of the country by a marked decrease in the vigor of both men and women.

In France this change of the population from country to city life is exciting the serious attention of government, while in our own country the deserted farm land in one State alone is enormous. It cannot be questioned but that in a few years this change will materially involve the physique and character of the people, wherever it operates.

Omitting for the present the consideration of occupation on the moral and psychical characteristics, we will note here its bearing in a physical way.

With the advance of civilization and the increasing divergence of mankind from primitive methods of life, occupations have become specialized, resulting in asymmetrical growth; that is, the growth of one part in a greater ratio, and often at the expense of another, frequently resulting in a positive deformity. As illustrative of this we will cite the tables of Drs. Chassagne and Dally, entitled "Influence Précise de la Gymnastique," being the result of an exami-

nation of the pupils of the military school at Joinville, France. The pupils were divided into five (5) classes: 1. Men who had followed rural occupations; 2. masons, builders, sawyers, wheelwrights; 3. smiths, farriers, mechanics, bakers, carpenters; 4. shoemakers, tailors, watchmakers; 5. students, clerks, architects. The growth and development of the first class was found superior in almost every particular; the upper extremities of the smith and baker were found unduly developed, while the lower were lacking in normal growth. The class leading a sedentary life was found deficient in muscle and overburdened with fat, while the fourth class, using a stooping posture, showed the evils of contracted chest and stunted growth. Other evidence is equally strong. Dr. Beddoes found the citizen of Glasgow and Edinburgh, on an average, from one to two inches shorter and from 15 to 20 pounds lighter than his country neighbor, and so it was with Sheffield, Exeter, and other cities in England.

It might seem that to state these facts was but to establish a truism; unfortunately, the *truth* is the phase of a question which we most reluctantly concede. Reflection on what has been said will, in most respects, answer the question suggested by Admiral Luce's paper, "What will be the effect, physically considered, on the sailor, by the substitution of steam for sail power?" The change will be for the worse; it will be closely akin to that following the surrender of country life for town life; it will be the result which will follow sending most of the crew below decks, in place of life on the upper decks. And what of those who remain? We might cite as the finest specimen of manhood, in all the attributes of courage and conscious power, the Norsemen and Vikings, exulting in muscles of iron, and as fearless as the very seas which they conquered—indeed, it is difficult to conceive of any avocation in life which more fully calls for the putting forth and exercise of all the powers of the body, and many of the finest qualities of the mind, than that of a seaman; the multifarious duties of ship's life diversify and equalize the efforts of the system, occupy and recreate the mental faculties as do no other. As to the amount of labor of which the seaman is capable and accomplishes, let us reflect that in going aloft he raises the weight of his body to a corresponding height, and that this is done often under the greatest difficulties, incident to wind and sea. If it be true, as good authority states, that a day's work for a strong, healthy adult is equal to 300 tons lifted one foot high, then we can easily understand how much in excess of these figures must be the work of a man who labors night and day, for the sailor off watch is actually at rest but a small part of the time. Then as to the character of the work, how wide is its range! Take, for example, an able seaman, whose muscles stand out in such relief as to be easily traced from origin to insertion, trained in many a contest, bending over the yards and snatching the sails from the very teeth of the storm. Contrast the man in this duty with him who works his watch-mark or embroiders his cap with a skill the daintiest fingers might envy. As a matter of fact, he has educated the "*fidicinales*"; a series of delicate muscles known only, as a rule, to fiddlers in the manipulation of the bow. The entire muscular system is complete in growth, and normal in devel-

opment—using these terms in their scientific sense—the first being a mere increase in anatomical elements, the latter expressing capability to assume higher duties and functions—the man has had, in plain words, a muscular education in all that relates to variety and association of complex and simple movement. Consider the picture which Admiral Luce draws of the topman aloft. His intelligence keenly alive, his special senses equally on the alert, his wiry and elastic muscles acting in exact co-ordination, so as to bring the various forces in the line of the desired resultant. And what can we say of this splendid animal in other respects? Is he really the "*bête noir*" that we do not wish to occupy the sidewalk with? We all know his vices. Do we remember his virtues? England owes a lasting debt to an old surgeon of the fleet, Dr. Thomas Potter, who in those days, when scurvy claimed more victims than the sea and the enemy combined, evinced an intelligence a hundred years ahead of his time, and a philanthropy unsurpassed, kept the scourge of ships in abeyance and the fleets well manned. He has left us this picture of a blue-jacket: "In the hour of battle he has never left his officer to fight alone, and it remains a solitary fact in the history of war. If in his amours he is fickle, it is because he has no settled home to fix domestic attachments; in his friendship he is warm, sincere, and untinctured with selfish love. The heaviest of metals, as Sterne calls it, becomes light as a feather in his hands, when he meets an acquaintance or old shipmate in distress. His charity makes no preliminary condition to its object, but yields to the faithful impulses of an honest heart. His bounty is not prefaced by a common though affected harangue, of assuring his friend that he will divide his last guinea: he gives the whole, requires no security, and cheerfully returns to a laborious and hazardous employment for his own support. Was I ever to be reduced to the utmost poverty, I would shun the cold thresholds of fashionable charity to beg among seamen, where my afflictions would never be insulted by being asked through what follies or misfortunes I was reduced to penury."

It is well said that the whole life of a sailor is one of confronting danger, and it is this which has indelibly impressed his character; it is the constant association with danger which gives the sailor less dread of it, and makes him in this respect, as in most others, "*sui generis*."

Such is the man as evolved under the old conditions: what will he be in the new?

Let us state the proposition as Admiral Luce puts it: "The complement of the Chicago is, let us say, three hundred and eighty-odd men. Of these there will be about one hundred belonging to the engineer's force. Throwing out the latter and the special class of petty officers, messmen, band, etc., there will be left about two hundred and ten or fifteen petty officers, seamen, landsmen and boys. Of these two hundred and ten or fifteen, it requires just two to take the ship to sea—one at the steam steering wheel, the other at the lead. We are not considering the engineer's force. That force does all the work in getting up steam, firing, running the engines, etc. Our present inquiry leads us to the deck. There we find in round numbers some two hundred seamen of the various classes. What part do they take in getting the ship to sea or in entering port? No part whatever."

"On going to sea, the anchor once catted and fished, which may be done chiefly by means of a steam winch, the man at the wheel and the man at the lead are the only ones who are called upon to take an active part in the operation." "So far from being of any use, the question is what to do with the crowd of men who are lounging about the deck." That the new life is in sharp contrast with the old we will all admit.

The Chicago has masts and sails, but we will leave them out of the count, as it seems the time must come when they will be as difficult to trace as the lost link in the process of evolution.

Let us not lose sight of the fact that while the sailor has been losing the characteristics of the old régime, he has been steadily acquiring those of his land congener—the soldier. What then of the change? Can great-gun drill, small arms, broadswords and similar exercises take the places of those which have become obsolete? It is impossible: the sailor, as we understand him, will go with the sails, and we shall see his like no more.

The difference in the two conditions is immense and various in its operation; it is not unlike that existing between a heavy Percheron and a Kentucky thoroughbred—it is the difference between a sham and a reality. The one condition brings into action the ambition, the courage, all the power, the very soul of the man; the other is one of a purely mechanical character, a perfunctory performance, an automatic process, and to many a drudgery. In the one the end is the safety of the ship, the life of the crew and the applause of heroic action; in the other it is a question of the liberty-list, a step to a higher rating, a bronze medal perhaps. The process will not be unlike that of the Scotch Highlander who gives up his life as crofter, a life where he has been face to face with Nature, and enters the factory at Glasgow or Edinburgh. One state imbued him with power and independence, the other makes of him a spiritless creature, who is conscious that a horse might do most of his task as well. In no way can the change be for the physical welfare of the man; in most relations there will be agencies for positive deterioration. It may be pertinent at this time to allude to the means by which we may in a measure counteract this result and preserve for our seamen at least a fair amount of health and something of the old spirit which animated them.

Primarily, we need a higher standard of recruiting both for the general service and apprentice system, and far more care in the selection of cadets at the Naval Academy. Let those who are to deal with this problem in future beware how they accept the too common statement that gunpowder has made any two given men equal. The time will never come when individual prowess will be below par in great physical contests: science is mighty, but science and human power are mightier. Dr. Parkes says on this point: "After the invention of gunpowder the qualities of strength and agility became of less importance, and athletic training was discontinued everywhere. But within the last few years the changing conditions of modern warfare have again demanded from the soldier a degree of endurance and a rapidity of movement which the wars of the eighteenth century did not require." We are told that in the athletic games of the Romans, officers and men exercised alike. Marius,

it is said, never missed a day at the Campus Martius, and Pompey was able at 53 years of age to run and jump with any soldier in the army. The sum of a man's ignorance was expressed by saying "he knew neither how to read nor swim." In feudal times, as we well know, skill in arms and strength of body decided the contest. At this time all European nations teach gymnastics systematically in their armies.

Our late war is replete with incidents where but for the individual strength of the promoter, many important enterprises must have been defeated. The courage, tenacity and endurance of Cushing and his crew are qualities as valuable now as when he destroyed the Albemarle. As before said, the best authority and ablest experience go to prove that physical strength, courage and daring go hand in hand. We must have good physiques to commence with. At the Naval Academy there is undue pressure in the matter of physical examination, brought about by position and influence, resulting in the acceptance of candidates destined to a short career, preparatory to the retired list. This statement is substantiated by the not uncommon retirements in the lowest grades of the Navy. A standard of physical strength for recruits is a purely arbitrary one, fixed by the State and based essentially on the demand for material, the scale varying with the necessities. Napoleon, in revoking his orders to enlist the youth of France, added that they but "strewed the wayside and filled the hospitals." For general service the best material of our Navy is from the merchant marine, and the worst the landsman. In the training service too great dependence is put on a lad's filling certain requirements in mensuration, and too little attention to heredity, temperament and general adaptability. He should be not only organically sound, but, to meet the life and hardships of a sailor, he should be robust. At one time the proportion of apprentices found physically disqualified was appalling. With a vigorous constitution to commence the race, the physical necessities for a good "man-of-wars-man" is more than half met. The introduction of seamen into the service through the training system is all-important: here the habits so necessary in after-life are engendered and fostered, especially a growing love for gymnastics and athletics generally. Let them continue to learn their seamanship as now, in *cruising sailing* ships. It would seem an imperative necessity to increase this arm of the service and offer greater inducement to make it a life-occupation, as it is estimated that now not over ten per cent continue in the Navy.

Other most important adjuncts toward securing the end in view will be gained in close attention to discipline which permits no idleness, but, as Admiral Luce suggests, it is difficult to know what to do with the crowd of loungers on deck. Great-gun drill, small arms, broadswords at sea; battalion drill and field sports in port. Let the liberty, as a rule, be in the daylight, and all hands on board to supper. (And it surely behooves officers to heed this injunction also.) A due regard to those most important functions of sleeping and eating must be had, and all provisions for a vessel leaving the country should be inspected by a board of officers who will form part of her complement. Errors in regard to the age and other qualities of provisions are gen-

erally detected when it is too late to find any remedy, and as a rule the alternatives are that the man shall sacrifice his stomach or the government sacrifice the provision—the former too often prevails.

In the economic processes of nutrition there is a condition known to physiologists as metabolism, the normal requirements of which are the supply of foods qualitatively and quantitatively of the proper kind, the laying up of this food in the body, a regular chemical transformation of the tissues, the formation of excretory products, and their timely and complete elimination from the system. The maintenance of this condition in proper adjustment means health and strength, depending closely upon a just relation between food, rest, recreation and labor. To preserve this happy state amid the increasing and perplexing problems which now environ us, demands all the care and consideration that we can possibly bestow, and when we have produced a sailor in good physical condition, experience shows that, as a rule, he is among the willing and intelligent members of the ship's company—apathy and inertia being often the result of obscure disease.

A conscientious attention to detail can alone keep our naval force in a state of fair physical efficiency, without which there can be no other.

Surgeon C. A. SIEGFRIED, U. S. N.—Not being a member of the Institute, and taking part in this discussion by invitation, I must apologize for giving you my views on this important matter of the Navy *personnel*. As Admiral Luce truly says, the object is to obtain discussion, to unify, if possible, our views, seeking only the improvement of the service. To much that is written by Admiral Luce there can be no objection. It is beyond argument, while, besides, I do not pretend to know much of the subject beyond the parts connected with the *personnel*, the health and strength of the men, their status and general condition for usefulness.

According to my understanding of the *present* needs and conditions of the service, the papers of Admiral Luce and Surgeon Wise on *personnel* are not very pertinent to the subject in hand, since we must take things not as we might wish them to be, but as they really are. None of us can deny the changed conditions, the dissatisfactions of men, the coming into use of inventions and practical use of forces in our Navy unthought of in the good old days of sailing ships and long cruises. I need not describe the ships in use by great naval powers and those we are putting in commission, and the prevalent idea that "cruising" will be given up. There are no governments extant building sail-power ships. Hence we must train our men to use these new tools. If men universally are being taught more, paid more for their labor, their social and ambitious cravings stimulated and fostered by our modern American life, we cannot do otherwise in the Navy. Why do men flock to cities, leaving the finer, more healthful country life for the slums and crowded tenements? It is because more mind satisfaction comes from it, they see and hear more; the modern spirit is striving for recognition and to find other things to do in rising to a higher plane. As a rule the American of the present will not easily submit to discipline or regularity of work, nor to force

compelling obedience, and all these are essential to efficiency. Hence our material comes from in great part the lower order of society—from the vicious, the unruly, and the foreign-born. Now, to train these for the present naval uses is a complex task, and only done partially and with loss and waste. If we were to go back some years it would be a simple matter to put them in ships, and by the force of association and attrition they would soon learn the simple duties that once pertained to our ships. They would in time be moulded into what is known as the "blue-jacket"—a being unsafe to the last degree in his tastes, habits and practices, but a good sailor and topman, handy with the plain old guns, with their creaking trucks and simple paraphernalia. Now, will this blue-jacket, so well able to pass the weather earing in all weathers, childish in many things, and not given to learning new tricks, once he is formed by the force he only respects while on board ship—will this man do for the machines now building for our Navy? Will he be of much use in the Navy—the mastless hulls, filled with intricate appliances that seem to be formed for purely destructive purposes only? There will be here and there lonely cruisers of course, as exceptions. All these craft need mechanicians, marine artillerymen, electricians, and a few lonely steerers and lookouts. I believe most of you admit that naval force *now* is only embodied and intrinsically potent in the inventions of recent years; this, in the full sense—ship construction, materials, guns, explosives, torpedoes, and the use of newly discovered forces and motors.

If the previous speakers argue in favor of sailing ship training to make men nervy and courageous in these days, such training is to my mind a great waste of time. Life is short, and familiarity with danger in any shape breeds contempt for it, and courageous nerve born of the trained mind is far more reliable. The statement that the blue-jacket of the good old days was a finely developed man, healthy and capable of any exertion or work, I take exception to. Neither did his mind control his actions. He had well-developed arms and chest muscles, but from the waist down he was weak in proportion; his legs were spindles; he was and is always beaten in tugs-of-war contests with the marines. I need not dwell on the quality of his self-control—his brain and morals. We must train the mind more; and if men in cities set apart time and place for health exercise, so must we do, as is even now done in other navies. The parts of the essays relating to the physiology of exercise, the virtues of the old sailor, and those matters, I do not argue against; they are matters of fact, but don't help us much here practically—they belong to books. It is not in reason to keep apprentices apart from ships; but will many argue successfully that the former or present system is anything but in great part wasteful, and only too well calculated to inculcate immorality and stunted physique? I know of reports of commanding officers who speak to this effect. Low, damp decks, dark corners, crowded living and berthing accommodations, fighting and oaths, no respect but for force—all this only too common. And the returning liberty-men! What a commentary on the system and the material of the blue-jacket of the past! Why stick to the past in *personnel* only? Less men will be needed for these new ships, and they must be better trained and paid; they

must be skilled of hand and self-respecting members of society, and willing parts of the force. Why must we accept the vicious and disobedient, in fact the worst boys of families, as a rule? What has brought the seaman's profession so low, into such disrepute? Can it be the well-known life of debauchery, the riot and excess upon all occasions? Or have the unhealthful, unnatural conditions of his life changed his nerve cells, so that his brain craves morbid excitement and excess, his brain becomes not a crown of reason over his actions, but simply guides a cunning animal? The average working life of a sailor in the merchant service is given as below ten years, and somewhat higher in navies! I deny that training of boys in sailing ships can be compared in usefulness with the training that can be given in what is known as the "Barrack System." From six months to a year ashore, and then to our ships as they are. Familiarity with modern appliances and dangerous instruments of warfare, mind and hand training, morals, drills, gymnastics, how to live in health by rule, the management of boats and small vessels by short trips—these all at first will go farther towards producing valuable material for our Navy. But the stock must be improved, the age limit changed to from 16 years to 20. The stunted, the vicious, and the whole idea that the Navy is a reformatory school, must be abandoned. As we gradually grow to this, so will our seamen increase in numbers and improve in quality, and *Americans* may be attracted. There are no American seamen now, comparatively speaking, and we must form a body to man our national arm afloat.

I take exception to Surgeon Wise's statement regarding the liberties of men and compelling their return to supper. The uneven and varying treatment of men in ships is one of the chief causes of dissatisfaction, as well as the manner of ratings, pay, etc. So long as the work and discipline permit, the return to supper of liberty-men is not in accordance with life and habits ashore, for, as things are, work ceases at sundown and recreation begins. Men must be treated differently, rated by boards of officers, broken only by courts-martial, better paid, and the service of the Government be made an honor for them as well as for the officers. If Admiral Luce means the smell of tar and hemp I quite agree with him, *that* is agreeable and healthful, but the "smell of a ship" denotes to me only lack of fresh water and honest cleanliness. Shining brass-work and bright upper decks have commonly gone with dirty rags and saliva for the former, white cloths covering long lines of ill-smelling clothes-bags and dark corners below, and a bucket of fresh water to wash the bodies of a gun's crew. Good sound brains and bodies, and with good morale, are produced without sending men to sea in sailing ships, and we need such for our new navy. It is more agreeable for us in some ways, and life at sea is romantic and often poetical; and who can deny the charm of sailing in the trades, the swish of the rushing waters as she heels over, the merry sail, oh!

Men are not free agents. We use new inventions because of some saving of time and labor in the attainment of an end, though we know the value of many old methods. If one refused to adopt new methods, or to adapt one's self to the new conditions, so much the worse for the man or the nation. There is nothing gained in pointing out the ugliness of things, the noise, ill-health

conditions, and brutal matter of fact short cuts to an end. Do men remain contented in quiet country ways, with their green fields and serene atmosphere, because some of us know it is better and more beautiful? Where is there beauty, peace or health in the modern town with its hideous suburbs, railway tracks, garbage heaps, its tenement districts, its crime and genteel beggary, and its wasteful government? These things are with us face to face, as we have the modern navy problem and the new war conditions; the marine arm of the national force and the *personnel* are forming under circumstances different from those preceding our time. If a modern ship-of-war can annihilate a whole fleet of old-time frigates, in just so much must the *personnel* be improved. We must come to this sooner or later. The officers and men must approach nearer each other; the man to know more—a higher type—and the officer to apply his own hand to the plow on occasions, to teach and as an example. There is less room for carelessness and incompetence due to neglect. I take it that we all know the chief characteristics of our pushing, inventive and leading officers, many among the younger men; they do not hesitate to use their hands to set matters going or to show men by example; they are in the work and realize the difficulties of the problem, and are helping on the newer state of things and the organization, finally the effectiveness of the Navy. The whole tendency of modern war forces is to obtain the utmost efficiency by the plain force of hard material agencies. Sentiment or romance don't apply in these times. Nations by diplomacy will avoid war to the utmost, but preponderating force must rule, and we know that they will be consummated by a few swift merciless strokes. Within recent years I have seen the flower of the navies of England, France and Italy, great monsters, mastless, and containing within them the best results of the science and inventive genius of modern times, and I beg to be excused from believing any longer in the training of our seamen in obsolete sailing ships. We now have no colonies, and I may say no merchant marine or sailors, and we must form our *personnel* from American citizens. The problem is hence more difficult for us, as we do not have the conscription, nor have we a surplus population or a great commercial marine, as is the case of England.

Boatswain H. SWEENEY, U. S. N.—*Gentlemen*:—Having been in the seaman-gunner class, I feel that I have been in a position to understand to a considerable degree their grievances. The question has been put, "How are the seaman-gunners to be induced to remain in the service?" This question arises from the fact that the majority of these men, after being trained, find that the Navy does not pay, in the majority of their cases, as much as their services will command elsewhere; therefore it appears to me that the way to retain them is to pay them fully as much as others will. It is, perhaps, true that, having been so well taught, they should feel themselves under some obligation to the Government, and for *that* reason remain; but even so, they are not violating any obligation by remaining out of the service after serving an enlistment and after being discharged. I have said above that in the majority of their cases they are not well paid, and I will try to show that such is the case. We will

say that there are six seaman-gunners sent to a vessel; they are all of the same class, possibly. One of this six will, in all probability, be rated electrical machinist, at $70 per month, one will be armorer, at $45, and the four others may get the rates of oilers or water tenders, at $36 and $38 respectively, and these differences of pay create a feeling of discontent. I think that the pay of this class of men should not be less than $45, even though the established pay of the rating which they hold be less, and if they are competent to fill the ratings which command a higher rate of pay they should be given the preference.

Commander C. M. CHESTER, U. S. N.—In reply to Lieutenant McLean's interrogatory, I may say that the men are kept in the Coast Survey from the fact that they are unhampered and can go or stay when and as they see fit. Apropos, however, of this question of increasing the inducements for seamen to remain in the Navy, I can say that officers are keenly alive to the necessity for doing so, and that boards have recommended increased pay and permanent ratings, and that such a scheme is now in the hands of the President. He has the authority to make the necessary changes, but not the means to pay for them, so that it is doubtful when this can be put in operation.

THE CHAIRMAN.—There are few of us, I imagine, who will not agree with Admiral Luce in insisting upon the great importance of the physical development of the men who are to form the crews of our vessels-of-war, and I for one agree with him in believing that the sailing ship is the best possible school in which a man-of-wars-man can be trained. There is no question, I think, that the "reckless daring so characteristic of the sailor," the quick-wittedness, the ready resource of the man who has spent his earlier years on the "giddy mast," are still the most valuable qualities to be sought for in the modern man-of-wars-man. But are we to go back to the sail period to procure these most desirable characteristics. Granting that spars and sails have seen their day and that the crews of our ships are to be deck hands hereafter, is there no way in which we can secure the results aimed at? Are we to look upon our vessels-of-war as gymnasiums merely? Were the Spartan youth not "trained to courage, and taught acuteness, promptness and discernment" without the assistance of spars and sails? Were the hardy fishermen of the Banks, from whom our Navy was so largely recruited in the earlier history of our country, the products of square rigs and towering masts? Were they not rather men who, from their earliest years, had been accustomed to taking their lives in their hands, who had, by hard experience in the face of danger, become self-reliant and quick-witted, and acquired those very qualities that made them so desirable an addition to the crews of vessels-of-war? It seems to me that it will not be necessary to take a step backward and supply our cruisers with full sail power in order to develop the muscles of our men, or to train them to that alertness which we all admire in the true sailor.

It must be for some years yet a matter of opinion as to whether, in order to get the most efficient service from our cruisers, they should carry any sails at all. It may be hoped that the value of sails for cruising purposes in that type

of vessels may be determined within a few years, when we consider that of the five first-rate steel cruisers on our navy list, the Chicago and the Newark are barks, the Philadelphia and San Francisco are three-masted schooners, and the Baltimore has military masts. Who can doubt what the answer will be? How much cruising could the Chicago do under sail? Does it not seem probable that she would be a more valuable vessel if the weight of her masts and yards and sails, and the storeroom full of supplies to keep them in repair, were replaced with coal? You cannot put everything into a ship. Sailing power must be sacrificed if we are to carry heavy guns and ammunition, and coal for long passages. The lack of coaling stations alone, it seems to me, is an argument for doing away with useless sails and increasing coal capacity.

Examples drawn from the Brooklyn, the Hartford and the Alabama prove little. The Baltimore could have made that hypothetical voyage from Honolulu to Valparaiso in twenty days and then had coal enough to steam thirty days longer, or perhaps twice as long as the Hartford could steam starting with full bunkers and helped by her sails, and when she had arrived she would at least be able to get away if she found it too hot. The Hartford, even if she had been able to make the passage before the emergency that called her there had passed, would be able neither to fight nor run away.

It seems to me that the Admiral's argument points rather to the great necessity there is that our country should establish coaling stations abroad. Perhaps it may be impossible that this should be done peacefully to any great extent, but it certainly could be done in the Pacific, and not improbably in the West Indies, without resort to force. We are wasting a golden opportunity in the Sandwich Islands at this instant. Wise statesmanship should anticipate the day when our increasing manufactures shall exceed the needs of our own people, and when our commerce shall be reaching out to the markets of the world.

By all means let us have training ships with full sail power in which to create our sailors. But let our cruisers not be hampered with useless material for the sole purpose of keeping the physique of our crews up to a standard which could be otherwise maintained.

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OFFICE OF THE ADMIRAL,
WASHINGTON, D. C., *June* 14, 1890.

*Dear Sir* :—I have read with much pleasure the article of Rear-Admiral Luce on "Naval Training." It is written with the usual ability that marks everything coming from his pen, and it would be well for the Navy Department if it should take to heart some of the principles laid down by the author.

I think Rear-Admiral Luce handles too tenderly those parties in the Navy, whoever they may be, who instituted the system of reducing sail power on ships-of-war and supplying everything with military masts, without considering whether the ships were intended as cruisers or as vessels for coast defense.

Not one of the new vessels hitherto planned or built is fit for war purposes in times of hostilities. "Cruisers" cannot cruise for want of sail power, and

so-called "line-of-battle" ships cannot go into battle for want of proper endurance. In time of war the result will be that the present Navy will be laid up on account of too much military mast and the entire lack of sail power, without which a vessel of the Navy is not a perfect machine. This question of sail power is one on which the efficiency of the service hinges.

It is not to be supposed that the series of able articles now appearing in the Proceedings of the U. S. Naval Institute will be without effect upon their readers, the young officers of the Navy, who are coming forward and expect to manage the affairs of the service. Every officer should bring to bear what influence he possesses to cause all cruisers and line-of-battle ships to be fitted with sufficient sail power to enable them to cruise for long periods at sea, if necessary, without entering port except for provisions, so that they may save their coal, as did the rebel steamer Alabama, for an occasion when they may be called into action or to chase an enemy too fast to be overtaken under sail.

This is the battle confronting the young officers of the Navy, and it must be fought *now*. We demand for our sea-going vessels thirty-five feet of canvas for each square foot of midship section. As to the coast defense vessels, they may be fitted with as many military masts as the constructors choose to supply. I think the article under consideration will have the effect of drawing more strongly the attention of the service to this vital question, and the fight should commence at once to ascertain whether the ships of the future are to be fitted out under the same régime of mistakes that has characterized the Navy for the past ten years, which has given us a "squadron of evolution" that cannot *evolute*, and, after training officers and men at the training-school under spars and sails until they become good sailors, has relegated them to ships where the military mast is the order of the day and where hoisting ashes is the nearest approach to seamanship an apprentice boy can learn.

I would encourage the discussion of this subject, and only regret that Rear-Admiral Luce did not say more about the matter, as no one knows better than he the necessity for keeping up that great element of power, the seamanship of the Navy, which has made our naval service particularly distinguished in the several encounters in which it has met foreign foes.

Very respectfully yours,

DAVID D. PORTER, *Admiral U. S. Navy.*

To the SECRETARY U. S. NAVAL INSTITUTE.

WASHINGTON.

Lieutenant E. B. BARRY, U. S. N.—Admiral Luce has given us an admirable essay on matter not, I fear, sufficiently often before the minds of naval officers of to-day.

The main idea of the essay is training for war. I venture to ask, however, if it be true the only preparation for war is to be found in knowing how to "hand, reef and steer," with some infantry drill thrown in? Is the soldier any less a soldier because he carries a magazine rifle and does not fight "shoulder to shoulder," as in days gone by? If the sailor of to-day differs from the sailor of Nelson's time, I take it the reason is because he is a better man—not inferior physically, certainly superior mentally—and in his fighting capacity measured to-day.

The decay (?) of the seaman has been going on for more than a hundred years, but to-day he is as active, as vigorous, and a thousand times better educated than was his great-grandfather. That the school of the topman used to prepare the seaman for his duties at the gun *physically*, no one can deny, but with change of battery and change in the method of working it, his old duties have disappeared. No longer does the handspikeman "heave" while the tacklemen "haul" until the gun points at the huge hull a few hundred feet distant and the gun-captain pulled the lock-string "when she was on." In those days it did not matter about fine shooting, and the vicious custom of making gun-captains survives to-day in our watch, quarter and station bills. Number 301 or Number 702 becomes captain of a gun, not because he can shoot, but because his rate as petty officer puts him there as a captain of top or something else, but not as a gun-captain: we have no such rate.

No wonder the "sailor" petty officers made the best records in the earlier attempts at systematic target practice. They were the only men aboard the ships that had fired great guns.

We are beginning to recognize that a man-of-war is intended to shoot her guns and to shoot them straight, and we are gradually putting gun-captains aboard ship who are meant to be captains of her guns. Let us have the rate next and get rid of top-captains in mastless vessels. The trained seaman-gunner is so vastly superior as a gun-captain to the old top-captain that comparison is useless.

Sails in a war-ship already have sunk to a subordinate position. If it be found the cruiser cannot be made effective in war-time with masts, yards and sails, she will be accompanied, of necessity, by a collier and coaled on her station. I think we all will agree with the Admiral that sails will be used in peace, especially on ships making long passages, but it seems a very doubtful question if a cruiser will not be "cleared for action" when war is imminent, rather than run the risk of being caught on her cruising grounds by a mastless vessel, able, owing to absence of spars, to steam much faster than she can.

The "base of supplies" of a battle-ship is almost anything selected for that base. It seems certain that fleets of modern battle-ships will not cruise in war-time without taking their base of supplies with them. A fleet as now organized contains supply-ships for coal and for ammunition. With their small steaming radius, modern battle-ships could not carry on an aggressive campaign without a movable base. What applies to them will apply to the cruisers.

Twin screws and the hull as built for them have overcome violent opposition, so it is but natural to suppose, were it acting to-day, the Naval Advisory Board of 1881 would favor twin screws for cruisers, whatever might be its opinion of sail power. I think the Admiral's remarks about the Brooklyn and the Baltimore rather favor twin screws.

In case of "strained relations" with Brazil I think the solution of the coal question for vessels like the Newark would be comparatively simple. Far different, however, would be the solution of the questions of fouling and copper sheathing. "As the cruisers already built have neither full sail power

nor copper sheathing, it is very evident," says the Admiral, "they are not intended for foreign service during war," and with this he dismisses them. This is not the place to discuss the merits or demerits of copper sheathing, but an adequate coal supply taken to the station will keep one of these cruisers going as long as the state of her bottom will permit, not to mention the strange anomaly called "coal protection," which vanishes through use just when it is wanted the most.

The Admiral says "the highest expression of the trained man is to be found in the able seaman and expert gunner combined." Now, what is to be the able seaman? Is he to be a man trained in the "school of the topman," when topmen, so called, are not wanted; or is he to be a physically well-developed, healthy man, with a gunnery training added? All things being equal, the trained shot can beat the seaman shooting; the eye is not made quicker nor the brain more active by "laying out and passing the weather earing." If this were true the best target practice would be sail and spar drill. No seaman is a good shot *because he is a seaman*, but because he individually has the aptitude for shooting, and with equal practice he would shoot just as well if he never went above the rail.

I venture also to differ with the Admiral about the typical apprentices returning from two kinds of ships. "It is scarcely necessary to add," he says, "that the former set (the better set) would, as a rule, express a partiality for the service, while the latter would not." When the better boys seem desirous to return to the service the cause is to be sought, not in seamanship, but in crew. Put a lot of apprentices aboard an American ship with an American crew and they usually will be content. But our Navy is not the place for Americans; our officers say openly they prefer Scandinavians, as the Admiral himself hints, and the American boys soon see their country's service is no place for them. As a consequence, few of the best boys re-enlist, except for the benefits of the gunnery class, and many desert disgusted before their term of service has expired. If we want these young men to come back, let us convince them they will serve on American ships. I believe an honest effort to man our ships with our own people, aided by the co-operation of commanding and executive officers, once the ships are in commission, will soon bear fruit; then the Olsens and Nielsons that refuse to become United States citizens, but who are so eagerly sought after by officers, will give place to Americans, who, even if not "so easily governed" as the mass of foreigners forming our ship's companies, will be ready to serve their own country and, if necessary, to die for their own flag.

WASHINGTON.

Ensign A. A. ACKERMAN, U. S. N.—While agreeing in many details with the distinguished essayist, some slight differences at the start lead to widely differing conclusions. It can hardly be otherwise. Youth looks with hope to the future. Age and experience recalls the circumstances which have developed their own powers and would have their successors fare as well. The certain advance of any art or profession arises from the change and readjustment of petty details, these later cause modifications on a higher plane. In

this way only can we explain why the views of the Advisory Board of 1881 would hardly be adopted in every respect by a similar board to-day.

The people want an efficient navy, and they will obtain it in time with no great haggling over the price. The prevailing sentiment will declare itself in favor of such types of ships as will best accomplish the most urgent duties of a navy, and the training of the crews will be best accomplished by perfecting them in the performance of their duties on those ships. One of the conclusions derived from the British naval manœuvres of last year shows it to be impossible to work a modern war-ship with a crew which has had only a general training on some totally dissimilar and possibly obsolete vessel. The multitude of changes in appliances since 1864 and lack of the correcting adjustments of war, places the problem on a platform of rational investigation. It should not be solved arbitrarily, and it cannot be entirely covered by experience. Let us consider a few of the changes since the time of the Alabama.

There are at present in existence 2,000,000 miles of land telegraph lines; 120,178 miles of cables, of which 13,178 miles belong to different governments. The whole of this has been built within the last fifty years, *and most of the cable within the last twenty-five years.* It takes twenty minutes to send a message to Egypt from London; less than an hour to Bombay; to China two hours; and less than three hours to Australia. This means of communication is rapidly extending. By the cable, commerce can now be warned when to sail and when to avoid danger; it can also be transferred to a neutral flag in a few hours after the declaration of war, even though it be in a far distant corner of the earth. As for the cruiser, once located, she can be pursued and captured or crippled even though victorious, unless she is able to stand punishment.

From Mulhall's Dictionary of Statistics we find that in 1864 the total registered steam tonnage of the world was 1,843,479; in 1881 it was 4,751,988; in 1888 it had grown, according to Lloyd's Register, to 7,021,000. Mulhall's Dictionary gives the ratio of steam to sailing tonnage in 1860 as 1 to 12. [This in itself is a commentary on Admiral Semmes' boast that, with half a dozen exceptions, all his prizes were taken while under sail and with his screw hoisted.]

In 1888, according to Lloyd's Register, the ratio of steam to sailing tonnage *was* 1 *to* 1.4. This is not a fair comparison of their respective values as carriers. The steamers of 1888 were much faster than those of 1864, they get over half as much more work out of their coal, make quick trips, and probably carry from five to ten times as much freight as an equal tonnage of sailing vessels.

This remarkable change makes even more probable the immediate observation and location of a cruiser, and consequent warning of commerce. Even though the cruiser's depredations were confined to the slow sailing vessels liable to run over time, she would probably be spoken every day by a neutral steamer unless operating in out-of-the-way districts. Even supposing the means of communication to be what they were twenty-five years ago, would the ravages of a dozen Alabamas be as great a national calamity to any European power as it would have been at that time? Certainly not if they

took their prizes under sail. A considerable proportion of the commerce of the world passes through our own or contiguous ports. We cannot consider much of this commerce liable to capture by cruisers, unless we declare war with a haste improbable under a government so efficiently checked and counterchecked. Commerce may perhaps be obstructed in the West Indies or with the British Provinces, but this commerce might with but little permanent loss be transferred to a neutral flag or be placed under convoy. It seems, therefore, that if we are not only to inflict damage on our enemy's commerce, but to exhibit such a power for the continued destruction of his property as will make him wish for a speedy though expensive peace, our most important work will be done in waters far from home.

Consider England's commerce in this connection. Her external trade was over £700,000,000 last year. Of this £144,000,000, *over one-fifth*, was with the United States, which has sent to England more than 40,000,000 quarters of wheat and flour in a single year. These stupendous figures only partly indicate the sacrifices these countries must make merely by closing their ports to each other.

The conclusion is irresistible that if "commerce destroyers" are to take any part in forcing an advantageous peace with a country that has already made such sacrifices for its principles, they must be able to accomplish an appalling amount of destruction. Not only this, but a large part of the commerce of England lies along the great trade routes from England to Gibraltar, through the Mediterranean to India and China beyond—routes lying almost wholly in enclosed seas and guarded by stations and battle-ships. It therefore seems evident that the commonly accepted type of "commerce destroyer" must be satisfied with the occasional capture of a slow steamer on the outside trade routes to the Western Hemisphere, South Africa, and perhaps Australasia. As these slow steamers are warned beforehand, and may be transferred, no damage is likely to be inflicted on England's commerce within sufficient time to influence a peace.

Nor would the total stoppage of this outside commerce work as great injury to English ship-owners as in the time of the Alabama. The rates of carriage to-day are but little more than one-twentieth what they were thirty years ago, and although by means of faster steamers the number of trips is increased, these ships are earning much less money than ever before. As for English manufactures, they may be easily transferred on interior lines and shipped in neutral bottoms over the few routes where the insurance would otherwise eat up the profits. All this, of course, is supposing that we had these trackless wastes efficiently patrolled.

It may now be positively affirmed that the roving cruiser can have little or no effect in bringing about a peace or relieving the pressure on our home ports. It would take a long time to seriously weaken such a colossus as England's commerce unless we attacked its main arteries. But to do that we must be able to fight. The attack must be prompt, determined and sustained; all else is mere bushwhacking of no national importance. We must expect to see some of our coast cities bombarded, some of our ports blockaded. Worse than

that, our labor market will be glutted; there will be no occasion for immense armies to resist invasion or to invade Canada, the border States can take care of that. But our wheat must rot in the granaries, our freight cars must rust on the sidings. There may be something of a grim satisfaction in the thought that those who most strongly oppose an increase of our Navy will be made to suffer first.

It must be admitted that while nearly all the world admired and comforted the Alabama, most European powers to-day would look with satisfaction on such a humiliation of the United States as would compel a modification of our protective tariff. Neutrals would submit to a great deal in order to bring about so desirable a result. Whatever is done, therefore, our coast must be kept clear of the enemy by a powerful off-shore fleet; while touch should never be wholly lost with a single one of the "commerce destroyers" which may form an integral part of the national defense. It is evident that if our cruisers are not to be sent out into trackless wastes of water, there to carry on the Alabama style of warfare, the arguments in favor of full sail power and sheathed bottoms lose all their force.

The difficulties of coal supply and fouling cannot be ignored; they must be met and overcome. To sacrifice the advantages of a modern cruiser in order to evade the accompanying difficulties, is to make our strategy dependent on inferior logistics. The essayist has given a number of possible examples in which modern cruisers may have been embarrassed by want of coal. Just sufficient data is furnished to demonstrate the peculiar weakness of these ships and the corresponding advantages of sails. Such a comparison is incomplete and, it may be said, unfair to our naval administration, as a notable lack of foresight or strategy is indicated in each example. Our Government sent coal to Samoa in a sailing ship: had the need of it been considered sufficiently urgent, it could have reached there much earlier in a steamer. The fastest steamer on the Greely Relief Expedition was the collier Loch Garry. The difficulties of coaling at sea have never been fairly met; when they are, they will be overcome. It will not be difficult for an eighteen-knot collier to keep in touch with two twenty-knot armored cruisers. She can run away from the battle-ships, and her consorts can take care of all else.

If all our ships were provided with long-armed swinging life-boat derricks, upon which an endless chain could be run, and self-bailing, unsinkable launches, coal could be easily transferred in a seaway from prize or collier to the launch and thence to the ship. After watching the Pacific mail steamers lightering freight in the heavy swell at Champerico and San José de Guatemala, it does not seem impossible to select a time when the same could be done farther out at sea, especially if the colliers were provided with efficient lighters. It will be said that this increase of complication may be avoided by the use of full sail-power cruisers; let us consider whether the accompanying disadvantages are not greater than those intended to be avoided.

In order to derive as much benefit from sail power as possible, the essayist has given the "commerce destroyer" but one hoisting screw. She cannot manœuvre, therefore, as well as the all-steam cruiser with twin screws, and

knows that in close fighting the latter will have the advantage; therefore it is presumed she will fight "not at very short range," though it is evident that the range will not be at her selection. Where the means of offense are so much greater than those of defense, the fight cannot be too fast and furious on the ship that wins the victory. The commander having the most numerous battery must feel that at long range he is simply playing with his good fortune and running up his casualty list. The quicker the enemy is made to feel his superiority, the shorter the battle and the less costly in men and equipage. The weaker vessel is the only one to benefit by prolonging the conflict, as a chance shot may cripple her opponent and at least shorten her cruise.

But suppose a full sail-power cruiser goes into action as valiantly as of old, will the gallant master's division be sent from behind their gun-shields out into a hail of iron and fire from Gatlings and rapid-fire guns to clear away the wreckage of sails and spars? Will not the crew suffer from falling spars and rigging and the langridge of outside boats? Will this not impede the service of the guns? Will not the commander, be he ever so gallant a seaman, find it better to steam ahead blindly in seeming rout and confusion, rather than foul his propeller in trailing wreckage? And will not, therefore, the faster all-steam antagonist select that quarter for attack from which it can deliver the most murderous fire with least damage in return?

Suppose the all-steam cruiser considers herself too weak to fight the sailing cruiser—the latter is shadowed and kept from doing harm. Vessels will be warned off just as the escaping Constitution warned the American merchantmen. The sailing vessel, bigger and stronger, attempts in every way to shake off her companion; she has been observed by neutral steamers, faster steamers of the enemy have run away from her, and soon from every quarter their cruisers will be sweeping down upon her. She might as well be captured as made useless by a crippling engagement, so she seeks to exhaust the steamer's coal. But her own is going fast, she dare not let steam go down, she is hampered by her sails, fearing that if set her antagonist will select that time for an attack. Her time of usefulness is over. Even though she seeks a fight with her nimble antagonist, she cannot force it.

It seems most certain that our possible enemy will be more inclined to peace by what our cruisers *may do* than by what they *have done*, and if that impression is not produced in less time than it takes to seriously foul a cruiser's bottom, then the attempt to force an advantageous peace by destroying his commerce is a failure, and we had better put the full strength of our Navy into fighting ships. Privateersmen can look after commerce. The best combination of commerce destroyer and fighting-ship capable of running away from battle-ships is the "armored cruiser," or at least a well-protected cruiser. There are many battle-ships such vessels need not fear, especially under certain conditions of weather. Their economical rate of speed should be high, permitting them to throw off clues to their pursuit and to appear unexpectedly in new fields.

They must also have the highest possible speed for the following reasons:

1. As the area in which the cruiser is located varies as the square of the

product of her highest speed into the number of hours since observation, the *inverse ratio* of this may indicate the comparative chance of finding her.

2. Without a very high speed the most valuable prizes would escape her.

3. Prizes would be made only after an alarming expenditure of coal in chasing.

4. The shorter the chase the less danger of interruption by darkness, fog or other features of weather, proximity of the enemy or neutral waters. The less danger of observation by neutral and others and consequent location.

5. When interrupted or pursued by a stronger but slower vessel, the higher her speed the more certain of escape; the shorter the dangerous period when accident or breakdown would be fatal; the less expenditure of coal. Even if the pursuer is faster, the chase will be longer and the opportunities of escape through accident, change of weather, etc., would be greater.

It is certain that if a naval architect can build an all-steam nineteen-knot cruiser in a certain displacement in order to devote 12 to 15 per cent of that displacement and 3 per cent more to masts, spars and rigging, he must rob her engines, her battery and her coal supply. A day or two less at full speed, a fourth less battery power, a knot or two less in the chase.

Training in some respects is a suppression of individuality, a unification of independent members of a society. No man or officer is disciplined or capable of creating discipline in its highest state who cannot suppress his individual traits for the time being in the humdrum of routine. A military life is full of petty exactions and observances. These expend much time, and by fatiguing otherwise vigorous energies, incentive to competition or progress is often wholly lost. After considering the changes in commerce and material since the time of the Alabama, it would be well to consider the changes in the people from whom our future man-of-wars-man must be drawn, now that aliens are no longer permitted to enlist.

Our people are better educated, better clothed and better fed than they were twenty-five years ago. [There are undoubtedly numerous cases of destitution in the land, but in almost every particular the individuals will be found to be the lowest type of foreign emigrant, and utterly unskilled. If they are skilled workmen they are certain, with the aid of public sentiment, to obtain satisfactory pay.] American workmen work neither as long nor as hard as they did in 1864, but they use their brains as well as their hands. In some respects old trades, through subdivision, have been swept away. Others may by contrast appear more gloomy than ever, but the elements of improvement are at work among them all. Hardly a day passes but what we hear of some great strike —not for bread, but for a principle—not for more money, but for less work and the same money. The spirit of progress is abroad in the land; the educated workman respects the law, for he has learned that it protects him as well as his employer. He is independent, as quick to discover and repudiate cajolery as to take a stand against arbitrary misgovernment. Times have changed; a strike is no longer made by a deluded mob of fanatics beating itself to pieces against the bayonets of soldiers, but a disciplined army, provisioned, paid and

led as such. As such the nation approves of them and values them, the sentiment of the public is with them as long as their actions are lawful. But a single overt act, and their cause is lost—they are scattered and swept away by a righteous public indignation.

Such are our people. This is a very different picture from that only twenty years ago. The American man or boy who ships to-day wants, should get, and the people will see that he gets, more consideration than would have been shown him then. The prospective reward must be greater also in order to retain valuable men. There is something terribly repugnant in the thought that we can only retain men in the service through their ignorance and helplessness on the beach. The remedy is plain; it will no longer be a harbor for aliens; it should not be for the weak and criminal, for stepsons and incorrigibles. The Navy should offer nearly the same advantages of education, social equality and home comfort that any plain trade does. Patriotism, a love of travel and adventure, should not be expected to do too much.

The contrast is not a pleasant one to the man who smarts under restraint aboard ship and is an uncouth "common sailor" on shore, and his brother who, with not a particle more of self-denial or self-restraint, reaps all the benefits that this free land bestows upon an honest workman.

Ordinarily the men supposed to be eligible for naval service in time of war are engaged in fishing and river work. The fact is, however, a more independent, yet helpless and useless, lot of men than these can hardly be imagined. Every State in the Union should send its quota to our training school, but these boys should be guaranteed something in return: 1st, a good common school education by regular certificated school-teachers holding naval warrants, drawing a pay and occupying the social position to which they would be entitled in private life. A rigid curriculum should be established and a military government free from any tinge of paternalism. It is hard to make a rollicking school-boy take much thought of the future unless the advantages of position can be brought home to him, so after spending one year at school they should be distributed among the various ships of the fleet. On these ships they should be carefully guarded and instructed, an officer being detailed to the ship for that special purpose. They should form a separate division of inspection and muster, but at quarters should be distributed as they could be used to best advantage. On no account should they be advanced, petted, or granted liberties not allowed the humblest landsman aboard ship. They should be compelled to obey their petty officers. One year of hard work in such a position should decide the boy whether the reward is worth the effort. If he elects to remain in the service he is returned to the training school barracks, given one year's additional schooling with practical exercises, and drafted to a ship for a three years' cruise. If at the expiration of that time his conduct has been good and he be able to pass such examinations as may be prescribed for him, he shall be admitted to special training courses in electricity, gunnery, torpedo practice, the construction of ships, guns, mounts, etc., etc. Not too much should be attempted in the one year or eighteen months' shore duty thus allowed. Whatever is done should be as thorough

and practical as possible. According to his merits, as determined by competitive examination, the seaman apprentice may now be assigned aboard ship to one of the inferior rates pertaining to his specialty, but if not so assigned he should be given a slightly increased pay on account of his examination certificate. Opportunity should be given him of studying both theory and practice of his specialty. On the completion of this cruise he may, on passing a proper examination, receive, with the approval of his late commander, a rate of petty officer of the Navy. As a large increase in number of warrant officers is needed to properly carry on the details of the work of construction of the new Navy, there would quickly be an opportunity of again promoting deserving petty officers. Warrant officers of a certain age and experience who shall have attained practical excellence in any branch may be given a commission and assigned to special duty. In this way an apprentice boy could be led to feel that with hard work he could keep mounting all his life. He would respect his seniors all the more through feeling how difficult it was to attain their position.

The most important step in the whole advance is the creation of petty officers of the Navy. At present we have no petty officers. Every man aboard ship feels that the petty officers get too little pay and consideration to amount to much. There is a very wide gulf between them and the warrant or commissioned officers and hardly any difference between them and their men. This trouble has been due to the fact that in order to educate young officers they have been required to perform the duties of petty officers; this has been excellent practice for the young officer, but it has made the petty officer a man of no responsibility. On modern ships, however, with their large and complicated batteries, there will be room for all, and every petty officer should be made to feel his responsibility and then treated with the consideration that that responsibility merits. He should be educated to command his men;—anything to break the widening gap between officers and men. To this end it is absolutely necessary that petty officers, until they are furnished by the training school, be taken from the best men in the fleet, be given comfortable quarters, and relieved to a certain extent from the many galling surveillances to which enlisted men are subjected.

With regard to the officers and men generally, it may be said that training is not at all progressive. So long as an officer or man performs his special duty satisfactorily, that is all that is required; there seems to be little or no preparation for higher duties. For the sake of its own interior training a ship must go to sea *frequently*, not necessarily continuously. At sea its manœuvring powers should be tested by every officer aboard ship. It is odd that the watch officer is not practiced more in these evolutions. There should be target and torpedo practice, boat expeditions, offensive and defensive fleet tactics off the ports and at sea; then let the ship go into port again, and require every line officer aboard ship to familiarize himself with the harbor plan and sailing directions, so that the entry will be a true lesson in piloting. Let the naval cadets trace the harbor plans and work out with the aid of boats cross bearings of turning points and range lines. Let them study the fortifications,

food, water and coal supplies, the language, habits and history of the people. Reduce the volume of their log-book copying and column-ruling, and improve its quality and value by only selecting important days. Let each divisional officer make it possible for his men, through a little judicious information, to spend a profitable and pleasant time ashore; and then to sea again to apply the quickened powers of observation to the ship itself and her functions. Let all drills go on intelligently, progressively; there are some movements of hand in all drills so important that they should be instructive; this faculty can only be obtained by repetition.

In training alternates to the various billets they should not be so hampered and nursed as to fail to form intelligent opinions of their own. This holds even more for the officer than for the seaman. The watch officer is relieved on going into port, and is, perhaps, stationed in the waist, where his duties are purely nominal, and nothing can be learned of the handling of the ship. He may never even learn how to swing his ship around an obstruction, the degree of helm for certain appearances of current, etc. He has his duties to attend to; piloting the ship is the responsibility of some one else. And yet it would be considered a disgrace for any officer to admit that he did not know how to handle his ship, how to compare his chart with the view around, when to start his turns and with what amount of helm. Somehow he is supposed to absorb all this practical information, when every one knows that it can only come with experience and the closest observation of those who are expert, the harbor and the chart, at one and the same time. This is but one phase. Instruct any officer in the duties of the next higher grade and you give him a bird's-eye view of his own. He becomes more competent, more apt to provide for contingencies, and more sympathetic and conscientious in his duty towards his superiors.

Lieutenant A. B. Wyckoff, U. S. N.—The paper on "Naval Training," by Rear-Admiral S. B. Luce, is most admirable. Mental, moral and physical culture are all absolute essentials in naval training. The kind and degree of the latter is likely to prove a most difficult problem on board our mastless vessels. How shall we obtain the same physical development of our seamen and the moral effect upon character which the work aloft gave in the old Navy? There is great danger that physical development will be neglected in the new Navy, with steam capstans, mechanical gun carriages, and no sails or spars. The pulling boat should give some legitimate exercise if not replaced entirely by the steam launch, but this is all that remains.

In my opinion, the essayist's solution of this question is the correct one. Our cruisers should retain their spars and sails and be copper-sheathed. The spars should be as light as possible, so that most of them can be stowed on deck when steaming to windward. The twin screws should uncouple, so that fair passages can be made and the coal saved for emergencies. I know there are serious objections to retaining spars on our cruisers because of the difficulties of finding stowage room for the sails, rigging, blocks, etc., and the dangers incident to battle from falling spars and top-hamper fouling the

screws. But if the naval architect can solve the problem of stowage room, let us retain our spars in peace times and dismantle the cruiser, if necessary, upon the declaration of war.

The condition of the Dolphin and Yorktown, at the time of this writing, sufficiently proves the necessity of copper sheathing and the great gain in economy and efficiency thereby.

The naval apprentice should be enlisted for eight years. Six months should be spent at the training station at Newport, sleeping in a hammock and instructed as at present, but with more modern appliances. His education should be continued on the training-ship for one year. These vessels should be fully sparred, and have modern batteries and a complete electrical outfit. The apprentice's first regular cruise should be on the light-sparred cruiser, where the work aloft will do so much to advance his physical and moral development. After three months' leave the apprentice could be sent to complete his enlistment on the battle-ship or coast-defense vessel. During both cruises his professional education should be carefully carried forward. The modern cruiser and battle-ship furnish every facility for completing the education of the apprentice, if regular and progressive instruction is given.

This can be done by the watch and division officers, if a little common sense is infused into the discipline of our men-of-war. The present age of the lieutenant's-watch officers of large vessels is forty years. Five years from now it will be forty-five years. Let them stand their watches at night at sea when another officer is needed as an efficient lookout on the forecastle. But in the daytime and in port let the ensign become the regular officer-of-the-deck, and the old lieutenant be relieved from "treading pitch" night and day, which he is physically incapable of doing and at the same time attend efficiently to the hundred other duties now incumbent upon him. The ensign can perform this deck duty just as well, and the lieutenant is left free to carefully carry forward the instructions of his division, man by man, in every necessary detail. In addition, the lieutenant can perform all the extra duties which now devolve upon the regular watch officer, and thus both will be left with some little time for recreation and the study necessary to keep abreast of the advance in their profession. It is an impersonal matter with me, as I hope my watch-standing days are over.

The petty officer of the service must and will be a more intelligent and important personage, and be fully qualified to always take charge of the boats except when cadets are sent in them for practice and experience. The ensign port-watch officer will thus be relieved of the most disagreeable duty which his rank has heretofore performed.

I feel sure the apprentice can be given all necessary knowledge in gunnery and electricity on board ship, and at the same time not be prepared for a lucrative position with some electric-light company, as our seaman-gunners seem to be at present.

WASHINGTON.

Ensign J. B. BERNADOU, U. S. N.—I have read this most valuable paper with care and attention. In a section headed "Sails" the Admiral has set aside

for a moment the subject under consideration, with the obvious purpose of throwing light upon the general conditions that are associated with naval training, and has taken up the question of our future naval policy.

Two lines of development, specified as being distinct from one another, are briefly discussed; the first assuming the construction of a fleet of vessels of the monitor type—to be left unsheathed, and kept within easy reach of the coal yard and the drydock; the second looking to the creation of a fleet of battle-ships and cruisers, of which the former may be fighting machines with twin screws and military masts, while the latter are to be provided with single screws and possess full sail power.

The national policy entered into at the close of the War of 1812, and the rapid growth at that time of our merchant marine, are dwelt upon as lessons for the future; the naval organization of the period is explained, and it is stated that "a revival of our early naval policy would call for a battle-ship on each foreign station, with a proportionate number of cruisers in addition."

In relation to this portion of the paper, certain questions suggest themselves. Do the conditions that obtained at the close of the War of 1812 bear close relation to those of the present day? Why are the two systems of defense above mentioned to be taken as entirely separate and distinct from one another? Why should coast defense be coupled with disappearance of merchant marine? And why should not naval development, starting from a defense basis, be extended to the limits of aid to the creation and support of a national commerce?

In 1812 the territory of the United States might have been roughly described as a strip of coast land backed by a wilderness; to-day the dimension of our country from east to west is greater than the sea-coast line from north to south; in 1812 we had but one great coast line, now we have two, and two land frontiers extending from ocean to ocean.

Owing to our fortunate natural position, however, and the character of our frontiers, the fear of a land invasion enters only as a minor factor into plans for the national defense. The points at which direct attacks are to be expected are upon our sea coasts, and these we must defend. Our Navy at present, with all vessels building and appropriated for, is but the nucleus of the armed protection that the interests of our country demand. It is necessary, therefore, to continue the development so auspiciously begun, and in doing this we must proceed with prudence and expedition, setting forth our wants in the order of their importance, and in the way best calculated to appeal to Congress and the people. We must excite in our behalf the sympathies and the interests of the capital, labor, production and manufactures of our country.

It is more than probable that so long as we are utterly without a mercantile marine worthy of our name, so long as we are willing to hire foreigners to make money at our expense by carrying our products over the seas, that our Navy will remain of very moderate proportions. The way to obtain a powerful navy is to build up a merchant service. As soon as our flag floats over American merchantmen upon all seas of the world, the great private interests at stake will develop a national character, and the need of adequate protection

for investment will be felt—a protection only to be afforded by numerous and powerful squadrons of vessels of war.

Until such a time comes, however, let us develop our Navy with a view to what it would be most needed for in time of trouble in the near future, and let us keep the heavier ships where they would then do the most good. We cannot get large sums of money to protect interests that do not exist and that, as yet, only exhibit a probability of development.

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ANNAPOLIS, MD.

Lieutenant WAINWRIGHT.—In his paper on Naval Training, Admiral Luce brings forward a number of points, all of vital interest to the naval service. To some extent they require separate treatment, and may be discussed more intelligently if placed under their several heads. The first question raised is, What class of cruiser shall we build? This may be considered from its strategic, logistic, and economic side. The second question is, How shall we train our naval seamen? This again may be considered under two heads—one the kind of training necessary to enable them to carry on their duties in a modern vessel of war; and the other, under the supposition that such training is not sufficient to develop a good fighting man, What additional training is necessary, so that the naval seaman shall not be found wanting in time of war?

First as to the class of cruiser. The cruiser has many important duties to fill. First and most important is as an adjunct to, and part of a fleet of battle-ships. Nothing has been shown more conclusively by modern naval manœuvres than the necessity of a number of cruisers to accompany the battle-ships. Without cruisers to act as scouts, the fleet is shorn of much of its strength and importance either for offensive or defensive warfare. For this service they not only do not need sails, but cannot afford to carry the weight. Speed is of prime importance, and the coal endurance must be greater than that of the armored vessel. The service must be performed under steam, and the cruiser must always be ready to do her uttermost and cannot afford to meet the resistance of the spars in contrary winds, or to carry the extra weight of sails and spars. The next most important service is to go to some foreign port, to protect our interests in case of disturbance. Here again speed is of prime importance. True, if she have full sail power she may arrive at the desired port with full bunkers and prepared to make a long stay without coaling. But frequently, if not usually, disturbances come without warning; and it would be a rash commander who dared to make his passage under sail, leaving our interests and the lives of our citizens unprotected for an indefinite time. Does any one remember the amount of time occupied by some of our old vessels in making the passage, with their screws hoisted, from New York to Rio? Some may argue that sail can be used with favorable winds; but this has always proved of doubtful economy in time and in coal. Take Admiral Luce's example of disturbances at Rio—certainly we must proceed under steam at a fair rate of speed. We must provide coal, not diminish the supply carried, by using a portion of the displacement for weight of spars and sails.

We need coaling stations, but without them we certainly can provide for such emergencies as the one above mentioned. Coaling steamers would be sent to meet the cruiser, or to accompany her. There is one thing certain, that if two vessels are built on the same displacement, the one that carries sails and spars must be less efficient than her competitor in some particular. Leaving out the question of stowage room and the possibility of disembarrassing the vessel of these encumbrances in time of actual combat, the weight devoted to sails and spars in the one vessel, can be devoted to armament, protection, machinery or coal in the other; her offensive, defensive or motive power, or endurance must be decreased to enable her to carry top-hamper. This is a law that cannot be overcome by the genius of the Naval Architect. He may be able to build one to carry top-hamper that will be the equal or the superior of his rival's mastless cruiser; but with the same genius he can himself build a mastless cruiser superior to the one he has built to carry sails. The remaining important war functions of the cruiser are as a destroyer or protector of commerce. The importance of the commerce destroyer is greatly exaggerated in the minds of non-professional men; but all naval strategists are agreed that while great damage can be inflicted on an enemy by commerce destroyers, they will have little effect on the ultimate results of the war. Our late war furnishes us with a good example: the Alabama and others destroyed an immense amount of property, almost ruined our ocean carrying trade, and the Alabama's work is frequently cited as an example by the advocates of commerce destroying; but it did not affect the results of the war even in the slightest degree; but few vessels were diverted from their real war duties, and the injury to the pecuniary resources of the country available for waging war was unfelt. And this is true of all like cases. Privateering and commerce destroying are the resort of the weak who desire to inflict some damage on the strong, but they have no lasting effect, and have never been the cause of closing a war—the weakest must go to the wall. Still we must be prepared to do something in the way of commerce destroying. Shall we require special cruisers with good sail power, capable of remaining at sea for a long time? Such vessels would labor under two grave disadvantages; they would be unable to catch merchant vessels of like or greater displacement, and must fall a victim to commerce protectors unhampered with sails. To protect our commerce as it grows and needs protection we must acquire coaling stations, and until we have them, confine our attempts to destroy an enemy's commerce within the limits of the steam cruiser.

The question of economy in time of peace may be raised also. This might be answered by the fact that it would be too expensive to design vessels for peace purposes only; but we can go further and show that even in time of peace sail power is an expensive adjunct to a modern cruiser. Admiral Colomb has calculated the amount of coal saved by the use of sail on a three years' cruise, and compared it with the interest on the cost of sails and spars, together with the expense of repairs, and found it would have been more economical if steam had been the only motive power used. A vessel in time of peace is only of use when in communication with the shore; the time spent going from port to

port is wasted except so far as training goes, and for the training of the officer, the vessel should be using the motive power that it would use in time of war.

The question of sheathing is somewhat outside of the subject of naval training; still the paper of Naval Constructor Hitchborn has been mentioned. It is a most able paper, but far from conclusive on the subject. There are many examples that may be quoted against him, and he ignores the fact that even vessels whose bottoms are sheathed with copper will foul in time. It is a question of degree only. All bottoms foul, and many examples of copper-sheathed vessels with very foul bottoms can be cited. The real question is, Is there sufficient difference in amount and time of fouling to over-weigh the known disadvantages of copper sheathing? The weight of expert testimony is against sheathing except for special purposes.

The question now comes to naval training. If sails are to be used no longer on men-of-war, we no longer need sailors. Our seamen must steer and heave the lead, they must be good artillerists, and should make fair infantrymen; and they must be able to handle their boats skillfully, both under oars and under sails. Steering is no longer a fine art, and the helmsman can readily be taught to keep his vessel close to the course. It is far more important to have a good marksman at the lockstring than it was of old. To make a direct hit is of more importance, the opening range is greater, more money is thrown away when shots are wasted, and the guns are instruments of precision, admitting of a higher grade of marksmanship. Our great-guns, small arms, torpedoes and electric lights, all require men of a higher grade of intelligence than was the old sailor. It would seem to be unquestionably a fact that the best training for work on a mastless cruiser would be on a similar vessel, unless such work is of a character to prevent the full development of the mind and body of the men. It seems to be almost universally admitted that the class of work required on a modern man-of-war is not of the kind necessary to keep the men in good physical condition; and, as for their minds, it is apt to turn the seaman into a mere mechanic and to destroy his distinguishing characteristic, his adaptability and readiness in emergencies. Gymnastic exercises have been proposed and even adopted, to some extent, for the improvement of the bodily strength of the seaman, and no doubt, if scientifically carried out, finer physical specimens can be produced than even by the old training with sails. Undoubtedly the strongest claim that can be raised for the retention of sails at the present time is that it was an excellent way of training seamen for their war duties, and the arguments on this head are the most difficult to answer. In questions of tactics, logistics and economics, facts may be brought forward to answer the arguments; but in questions of training, the new methods have not been systematized sufficiently, or long enough in operation, to offer any results as evidence. We know that the old sailor was a fine specimen and answered his purposes admirably;—will the new seaman be as good in his place? A great deal of sentiment is mixed up in this question: much romance hangs over the career of the sailor. Many of us have devoted a large portion of our lives to learning how to handle vessels under sail, and no one with more marked success than the writer of the paper under discussion.

We know that a man who is a good sailor must have a quick eye and be ready in emergencies, and that he can readily learn to handle a vessel under steam properly. But, as far as the men go, have we not exaggerated their capabilities in our minds? A little while ago, if the question arose of introducing a new weapon, the cry was raised, it is too intricate to put into Jack's hands. A good topman or good boatswain's mate was put at the lockstring; occasionally he was a good marksman, but frequently he was a very poor one. He was courageous, possibly more so than the average soldier, owing to the frequent encounter of dangers during a sea life;—if sails are retained for training solely, will they still have this same effect? I hardly think so; in time of real hazard, rather than incur real danger, the sails will be furled, and the commander, who would not be justified in risking the lives of his crew and the safety of his ship, would place his reliance in his steam power. Certainly, as a mere exercise, the gymnasium might take the place of the sails and spars. It may be well to retain them on vessels devoted to the training of apprentices; some little knowledge of sailorizing is still of advantage, and they could be utilized for physical culture. But with the sails there must also be modern equipments and modern weapons. The boys should be made familiar with their real surroundings, and not with some ideal condition pertaining to ancient romance.

The question of retaining the apprentices and seamen in the service is one both of economics and of training, but largely the former. Will any amount of training on board ship, living on board ship, teach a boy to love the sea? If he have clean, well-lighted barracks when not cruising, in place of being crowded on an old, decaying vessel; if, when he is at sea, he cruises in a modern ship with modern weapons, is he not more likely to learn to love the service? True, by training men sufficiently long on board ship, they may be unfitted to earn their living on shore and thus forced to re-enter the service; but we do not want this kind of man, for surely, when his term expires, he will spend his time on shore in debauchery, and only re-enlist when forced by his necessities, bringing with him a constitution sapped at its foundations, and a temperament dissatisfied with its surroundings. The wages, comforts and certainty of position of the seaman must be such as to induce him to remain in the service. The apprentice should be required to make one cruise after he has reached the age of 21, then he will be better fitted to make a selection of his future life. If he then finds he has good pay with reasonable opportunities of increase, that he is well treated and his comforts fairly well looked out for, and his position certain, he will choose to remain in the service. One thing will greatly add to continuity of service, and that is the abolition of the receiving ships and adoption of barracks in their places. If the men can live in the barracks, with the ordinary privileges of other men of their class, they will find that they are better lodged, clothed and fed, have more to spend than those of their own class, and they will remain contented with the service, while their training can be conducted under more favorable conditions than on a receiving ship.

We will always need seamen; they need not be sailors and they must be

more than mere mechanics. A higher type of man is necessary than of old: he must be more highly educated, have better morals, and be more carefully trained. His regular exercises can be supplemented by gymnastics; and, if to encounter danger is necessary, he may confront it in boats under oars and sail, in bad weather and through surf. The ship-of-war must be allowed to follow out its lines of highest development, and the seaman must be trained to suit the development of the machine and to use it to the best advantage in time of war.

SAN FRANCISCO.

Lieutenant J. C. WILSON, U. S. N.—Having received an advanced copy of a paper on Naval Training, written by Rear-Admiral S. B. Luce, with a request to send opinions, etc., on the same, I feel inclined to comply with the request, not because I believe I can discuss the subject as ably as the writer has done, but because I believe it is desirable to have as many expressions of opinions on this important subject as possible. I regret that absence from the city prevented my receiving the paper in time to study it thoroughly, and that lack of time precludes anything but a brief discussion.

The reasons given by the writer for rigging our cruisers with full sail power are very pertinent, and he presents the subject in a manner not generally considered by the naval expert, viz., the influence of the life of a topman on his character as a man-of-wars-man. There can be no question but that constant necessity for activity of action both of body and mind, exposure to performances of hard and perilous duties, and the sacrifice of all other considerations to those duties, as well as familiarity with danger, cultivates the highest attributes which combine to make the heroic sailor and model man-of-wars-man. This is certainly a point in favor of full sail power on our cruisers worthy of much consideration, but it is after all secondary to the other reason given for advocating sail power, viz., the ability of the cruiser to cruise independently of coaling stations. This in our country becomes a very important consideration, and the writer aptly illustrates how either the Charleston or Newark in time of need might be worse than useless.

It is a question which we must decide for ourselves, as the circumstances governing other nations in their construction of a navy may be entirely different from those which should govern us. We cannot afford to stand by and let the experts of other countries study out questions of construction, equipment, etc., considered best for their naval policy, and then adopt them for ourselves. We must study the conditions under which our ships are to be used, and construct them accordingly.

Practically speaking, we have no coaling stations, and consequently, in time of war, no means of obtaining coal out of our own country. Without coal our cruisers of course would be useless, and they would be under the necessity of always remaining within striking distance of a home port. Under these conditions their sphere of usefulness would be very much reduced, and the boast that we could sweep the high seas of an enemy's commerce could hardly be realized. It is very desirable, if not indispensable, that a cruiser should be able to keep the high seas for months at a time, not only to reduce the proba-

bility of capture to a minimum, but to be able to remain out in search of merchant vessels.

The reason assigned for making our cruisers practically mastless is to obtain the maximum of speed and handiness, both very important qualities for a cruiser to possess. She needs speed to be able to choose her distance in case of being brought into action, or to escape from a more powerful foe, if necessary. The experience of the Alabama, as quoted by the writer, illustrates that great speed is not essential to a successful commerce destroyer.

We then have the question before us in the equipment of a cruiser, whether it is better to obtain increased speed and handiness by discarding all sail power, or to sacrifice a moderate percentage of these qualities in order to obtain the advantage of a cruiser's being able to keep the high seas independently of coaling stations. I do not think there can be any question as to which alternative possesses the greatest merit for our cruisers, which cannot depend on coaling stations. I agree with the writer that they should be rigged with sufficient sail power to enable them to cruise under sail alone, thereby sacrificing, if necessary, a moderate percentage of speed and handiness. Accepting this idea as correct, it becomes necessary, as the writer remarks, to so construct and rig our cruisers that the minimum amount of speed and handiness will be sacrificed, and it would seem not a very difficult problem to find a system of telescoping the masts, and stowing the yards, so that these qualities would be but little interfered with. The screw could be disposed of either by hoisting or uncoupling, as deemed most advantageous. As twin screws seem to give the best results and are desirable for many reasons, they might be fitted to uncouple.

The question of sheathing the bottoms of iron and steel ships seems to me to have been pretty generally decided against the practice. I think it is on record in the English service where sheathing has been removed because it was found to be positively dangerous to the safety of the vessel on account of the galvanic action set up between the two metals. Again, it increases the displacement (and, in consequence, reduces the carrying capacity somewhat), besides changing the lines of the immersed section of the ship, which combine to decrease the speed. The only advantage of sheathing is that it renders the ship independent of docks, and this of course is a very great one, but as a ship can now go from six to eight months out of dock without serious consequences, it would seem that the disadvantages of sheathing more than outweigh the advantages. I should conclude, then, to let the cruisers go unsheathed, but by all means give them sufficient sail power for cruising purposes. Speed under sail is not essential, as with our modern high-power guns of great accuracy merchant ships can be brought to at longer distances than they could during the days of the Rebellion, and, in case of necessity, steam can be used.

The advantage to be gained by sail power in ships in the education of the man-of-wars-men, as so clearly set forth by the writer, applies especially to the apprentice system, and there is even more reason for retaining it on "training ships" than on cruisers. We should have at least one modern-built, armed and equipped small-sized cruiser, with full sail power, for the advanced class of

apprentices, suggested by the writer. The younger boys could learn the duties of a man-of-war sailor in any ordinary cruiser, and should be kept at sea (or at least cruising) constantly until promoted into the advanced class on the modern ship, where more time could be spent in port and devoted to gunnery and similar drills. The barrack system, which I think should be adopted in place of the receiving ship for the "general service recruit," would not do for the apprentice system.

In this discussion I have confined my remarks to the points brought out by the writer, but believe that the whole system of recruiting and training of men to meet the requirements of the new Navy should be radically changed.

I think the thanks of the service are due to Rear-Admiral Luce for so ably opening the subject of "Naval Training" for discussion, and so clearly setting forth the necessity of sail power in our new cruisers.

# PROFESSIONAL NOTES.

## DETERMINATION OF THE ACTUAL TRACK OF A VESSEL DURING TRIALS ON MEASURED COURSES.

By Ivo Chevalier de Benko, Lieutenant, Imperial Austrian Navy.

[Translated by Lieut.-Comdr. E. H. C. Leutzé, U. S. N., from *Mittheilungen aus dem Gebiete des Seewesens*, Vol. XVII, No. 12.]

In the following we have in view only the cases where the greatest exactness is necessary to determine the actual wake of a vessel and the time required to make it, as for instance in trials for speed.

As the contracts with shipbuilders generally call for premiums or penalties for 0.1 of a knot of speed, we will assume that any method which will assure exactness to that limit will be permissible.

Speed trials consist in running the ship over a well known or easily measured course and taking the exact time required to do it.

The exactness of the results will therefore depend, 1st, on the exactness with which the ship is kept on the measured course; 2d, on the exactness with which either the prescribed or the actually made course can be determined; and 3d, the exactness with which the time is taken.

Under 1 we can omit such faults as would arise from the state of the sea and strong winds, as they are difficult of determination, follow no laws, and would generally be avoided by choosing suitable weather. Their effects could be felt in the difficulty of keeping the vessel on her course, she being exposed to forces which may be considered to act in the same direction as the course and also perpendicular thereto. The harmful influence on the machinery caused by the laboring of the vessel would also have to be taken Into consideration.

The first two mentioned causes of error are, however, similar to some which are unavoidable during good weather, namely, the errors due to bad steering and the influence of currents.

The error caused by bad steering can be compared with that made by the surveyor when he chains distances which are to be measured. In that case nearly every link of the chain makes a small, unmeasurable angle with the direction of the actual line to be measured.

We may perhaps assume that as a general thing a ship will run in regular succession three minutes on her course, three minutes on one side and for the same space of time on the other side, and will then return again to her course for another three minutes, etc. The time of a period would therefore be nine minutes, during two-thirds of which the vessel would be on her course. It would be easy to determine, arbitrarily, the length of the curves and their number, and also the angle of deviation from the course. After that a formula could be established for this error. For instance, if the deviation from the course should be a ¼ point and the distance 30 nautical miles, we would have the formula $30 \times 1852\ (1 - \cos \frac{1}{4}\ \text{point}) = 67$ m. or 0.1206 per cent. If, then, the speed of the vessel had been 20 knots the error would only amount to

0.024 knot (this would be the maximum error no matter how much of the time the ship is off her course, as long as it is never more than ¼ point).

It will therefore be seen that the error caused by bad steering is small, and by close attention to the steering it would be so reduced as not to be large enough to be taken into consideration. If it is deemed advisable, however, to take this error into consideration, it would be necessary to note the length of the times and the amounts the ship deviates from her course, and also where the deviation reaches the maximum; the amount of the latter must, of course, also be noted.

The following will show how a convenient formula for this calculation can be established.

The curve representing the course of the ship is similar, as far as the error in question is concerned, to the motion of the pendulum.

The angular velocity of the sheering vessel is comparable to the velocity of the pendulum. Supposing then that the steering is regular, the error will then be the difference between the curved course *ABCDA* and its projection *AA*, Fig. 1.

FIG. 1.

It would therefore only be necessary to establish the formula for the curve and calculate its length.

In actual practice, however, the curve is too irregular to conform to a fixed law, and it would be necessary to observe the deviations ($a$), noting the time in minutes during which each deviation exists, and then calculate the error due to each $a$ and its corresponding $t$, as follows:

From Fig. 2 we have

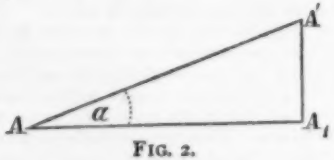



FIG. 2.

$$AA_1 = AA' \cos a \quad \therefore f(\text{error}) = AA' - AA_1$$

$$= AA'(1 - \cos a) = \frac{tv \times 1852}{60} 2\sin^2 \frac{a}{2}$$

$$= \frac{1852}{60} \sin 1'' \left( \frac{2\sin^2 \frac{a}{2}}{\sin 1''} \right) tv = [6.17510 - 10]\, vt\Delta,$$

in which the quantity in parenthesis is the logarithm of the actual coefficient, $\Delta$ is the well known number of Delambre of which there are tables, and $v$ the mean velocity obtained by the formula given on the last page of the article. The total error is the sum of the partial errors thus obtained, *i. e.*, $F = [6.17510 - 10]\, v\Sigma t\Delta$, and if $t$ be the same for every observed value of $a$ it may be written before the sign of summation, and the calculations can be made by means of tables of the number $\Delta$ which are entered with $a$ to degrees and tenths.

2. If so called "measured miles" are not available, it can be presupposed that it is possible to get accurate data for the position of and distances between prominent points on the coasts from the Coast Survey Office. The probable

errors which are given by this office, in connection with other data, will determine whether the chosen points are sufficiently accurately located.

In choosing a course its length should be the first consideration (if 1, 2 or 3 miles are wanted). The length will be governed by the requirements of the case. After that the situation and direction can be determined. In regard to situation, it is necessary to choose a location free from strong winds, heavy seas and irregular currents (specially those near the mouths of rivers). In regard to direction, it is desirable that it should be normal to that of the ranges which are to determine the limits of the run, that the marks of these range lines should be distinctly visible, that the marks of each range are not too far apart, and finally that the ranges both have the same relative direction to the measured line. As the ranges should be sharply defined, large objects, such as church steeples, should be chosen; coast lines, etc., which are changeable, should be avoided.

It is not essential that the ranges mentioned above should be perpendicular to the course, but it is necessary to have at each range a third fixed point upon which angles may be taken for determining the exact points at which the line actually cuts the limiting ranges. The moment the limiting range $AB$ is on, the angle between $A$ and $C$ (Fig. 3) should be measured, and it will then be known, the triangle $ABC$ being known, at which point, $E$ or $E'$, the range has been crossed. If $A$ and $C$ are not too high it will not be necessary to reduce the measured angle to the horizon; it is not difficult to prepare tables for this purpose, which are entered with the heights of the objects and the measured angle.

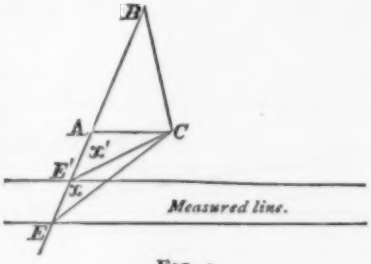



FIG. 3.

The strict formula would be $\cos \zeta' = \dfrac{\cos \zeta - \sin \alpha \sin \beta}{\cos \alpha \cos \beta}$, in which $\zeta$ represents the measured angle, $\alpha$ and $\beta$ the height angles of the objects, and $\zeta'$ the projection of the angle $\xi$.

As $\alpha$ and $\beta$ are generally small, Legendre's approximation formula can be used,

$$x = \left(\frac{\alpha + \beta}{2}\right)^2 \tan \frac{\zeta}{2} - \left(\frac{\alpha - \beta}{2}\right)^2 \cot \frac{\zeta}{2},$$

to calculate a small table for the required correction. The table would be entered with $\alpha$ and $\beta$ for height of eye from 3 to 8 meters and with $\zeta$ to degrees.

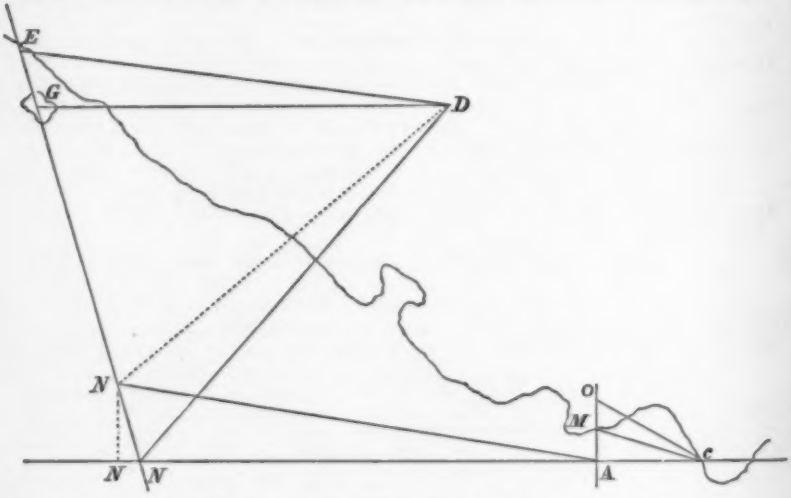
But as (Fig. 3) the angle $AEC$ should be chosen as near to 90° as possible, this correction of the observed angles becomes of no importance as long as $A$ and $C$ are not located too high.

I will now show how it is possible to find without much trouble the correction to be applied when the range is crossed at $E'$ instead of $E$ as required. It has already been mentioned that if the ranges determining the limits of the course are not perpendicular it will be sufficient to have triangles at each end whose position and distance from the course are known. For instance, in Fig. 4 $AN$ is the course and $OCM$ and $EGD$ the known triangles; the angles $OAN$

and $ANE$ and the distance $AN$ are then also known. The lines $OMA$ and $EGN$ represent the limiting ranges. In order to verify if the ranges are passed at the prescribed points $A$ and $N$, the angles $MAC$ and $GND$ are measured; they are of course known, as the situation of the triangles and their distance from the measured line are known.

The fact that in Fig. 4 the prolonged course $AN$ goes through the triangle point $C$ is irrelevant to the matter, it is only thus indicated to show how easy the reduction of the course becomes when the ranges are perpendicular to the course and its prolongation cuts through one of the points of the triangle.

Let $omc$ and $egd$ represent the sides of the triangles, $s$ the course, and $a$ the verification angle $OAC$, and $v$ the angle $END$. If the angle measured on the range $EG$ be $EN'D = V'$ instead of $END = V$, the vessel will then have




covered the distance $AN' = s'$ meters instead of the distance $AN = s$ meters, and $s' - s = c$ will represent the correction due the difference $v' - v$ in the angles.

As the triangle $END$ can be solved by means of the triangle $EGD$ and the angle $V$, it is proper to assume that the piece $NN'$ belonging to the triangle $ANN'$ can also be considered as the change in the side $EN$ of the triangle $END$ due to the change in the angle $V$.

$$NN' = DN \frac{\sin (V' - V)}{\sin V'}.$$

In this formula only $V'$ is changeable; it is therefore easy to prepare a table for $NN'$ whose argument is the corrected angle $V'$ (corrected for instrumental error and reduced to horizon).

$AN' = s'$ can be found without difficulty from the triangle $ANN'$, as $AN = s$ and the angle $END$ is assumed to be known. We would have

$$s' = (s + NN') \sqrt{\frac{1 - 4sNN' \cos^2 \frac{N'NA}{2}}{(s + NN')^2}},$$

where the right side of the equation only contains known quantities, and it would be again easy to prepare a table for the different values of $NN'$. But

as $NN'$ only changes with $v'$ it becomes possible to combine the tables for $NN'$ and $S'$ into one table for $S'$ with the argument $v'$. In order to facilitate the computation of the table an auxiliary angle ($\cos^2$) is introduced under the sign of the square root.

But it now becomes necessary to mention why the range is crossed at $N$ instead of $N'$; in other words, which part of the value $NN'$ must be attributed to the engine. It can be considered that $NN'$ is caused by poor steering, incorrect compass error, and finally through the component of the current normal to the course. It has already been shown under 1 how to eliminate the error due to bad steering; the error due to the normal component of the current can be eliminated by the projection of $S'$ on $AN$, or by finding the means of calculating the rapidity, namely,

$$S = s + NN_1 = s + NN' \cos N'NN_1,$$

the error due to the influence of the compass error. There only remains then the error due to faulty compass correction. This can be reduced to a minimum by establishing on the coast a range parallel to $AN$ on which the error can be accurately determined.

It is therefore necessary to make the following calculations for each limit of the measured course:

$$NN' = DN \frac{\sin (V' - V)}{\sin V'}$$

and

$$S = s + NN' \cos N'NN_1.$$

Therefore if you let $NN' \cos N'NN_1 = C_a$ and the analogous quantity for the other limit equal $C_a$,

$$S = S + C_a + C_a,$$

from which a table with double argument (the verification angles at $A$ and $N$) can be constructed beforehand and the determination of the speed easily accomplished.

It will be seen that $S$ is sharply defined as the speed maintained by the performance of the engine; it is entirely independent from the "*cross*" component of the current. It furnishes at the same time a good guide for selecting the course; should it, for instance, be a short course that it is repeatedly run over in a comparatively short time, the current can be considered the same in any two consecutive runs, so that the place can be selected without paying any attention to the currents. Should it be a long course, however, then it would be well to select a place where the current sets across, so that it can be accurately determined or eliminated by the method we have above indicated.

If it is certain that the current sets across it is of no importance if its strength is constant or not.

In conclusion I would call attention to the fact that the mean of several runs over the same short course is not always accurately determined; the first and last run should be only given half weight. Under supposition that the current remains constant during the run in one direction and return, we have

| Run. | Partial Mean. | Mean. |
|---|---|---|
| $A$ | | |
| ..... ..... | $\frac{a+b}{2}$ | |
| $B$ | | |
| ..... ..... | $\frac{b+c}{2}$ | |
| $C$ | | |
| ..... ..... | $\frac{c+d}{2}$ | $\frac{1}{10}(a+2b+2c+2d+2e+f)$ |
| $D$ | | |
| ..... ..... | $\frac{d+e}{2}$ | Or with only five runs |
| $E$ | | |
| ..... ..... | $\frac{e+f}{2}$ | $\frac{a+2b+2c+2d+e}{8}$ |
| $F$ | | |

or in general

$$V_n = \frac{1}{2(n-1)} \; V_1 + 2(V_2 + \ldots + V_{(n-1)}) + V_n).$$

The assumption that the current does not change in a certain time becomes more tenable as this time is reduced. On the contrary it can therefore not be assumed that the current remains the same during all the runs, but it is perfectly correct to assume this to be a fact during two consecutive runs.

3. I have shown under 1 how the error due to bad steering can be calculated, and under 2 I have shown a method to eliminate the compass error and cross current. The time observations remain to be discussed.

It is important the coincidence of the range signals at both ends of the run should be observed by the same person, and it is not immaterial to whom this duty is entrusted. The choice of a proper person becomes more important when the ranges do not cover but pass above and below each other.

It is dangerous to use the sight vane of an azimuth compass, as it may lead to grave errors, as it is very difficult for the observer to judge if the compass is horizontal, that is if the wire of the sight vane is perpendicular. On the other hand there are persons who have peculiar faculty for judging vertical coincidences. During calm weather a plumb-bob may be of service.

The time is generally noted with chronoscopes (Marenzeller watches); this seems to me to be superfluous unless the watches are repeatedly compared with a well regulated chronometer, as the irregularity of the personal error will certainly be considerably larger than the rate of a good chronometer. I would prefer to mark time by a good chronometer which beats to seconds, the seconds to be counted aloud by an assistant.

An error of 1 second in running over a course of 1 mile at the rate of 20 knots amounts to $\frac{1}{180}$ of the observed time or 0.5 per cent, which would give an error of 0.111 in the speed to be determined; it is therefore plain that the times of observations during such run are of the utmost importance. It becomes therefore necessary that the comparison of the chronoscope with the chronometer should be correctly taken, that is, at the same temperature and in the same position.

The valuation of the comparisons is simple.

I will review the methods recommended in the above.

Five persons are required for the observations:

One person to observe ranges.
One person for marking time.
One person for taking the angles.
One person to observe the steering of the vessel at the compass.
One person to assist at the compass (should be provided with a watch).

The next step is to establish the course by means of the verification angles reduced to the horizontal plane; the correction for poor steering is then applied. The preliminary data required for the latter, namely the speed, is obtained by dividing the length of the course by the time according to the formula quoted below.

Finally the observed times must be corrected after comparison, and then the equation

$$V \text{ knots} = \frac{S \text{ Meter}}{T \text{ Sec.}} \times \frac{3600}{1852} = (0.28866) \frac{S \text{ Meter}}{T \text{ Sec.}} \quad (1852, \text{ J. P. M.})$$

computed. In this equation $S =$ the exact course in meters, $T =$ the exact time in seconds, and $V$ the speed in knots. The number in parenthesis is a logarithm.

The above method is particularly useful on long courses, where steering on a range cannot be resorted to.

# SPEED TRIALS OF FAST SHIPS.

## A Review.

The Journal of the American Society of Naval Engineers, Vol. II, No. 1, contains under the head above, two highly valuable papers on the subject of speed trials, the object of the discussion being to bring out the best method of ascertaining the speed developed by the new protected cruisers, Philadelphia, San Francisco, etc. The idea of the speed trial is to ascertain the exact distance a vessel can cover in four hours, uninfluenced by wind or by current. A scientific standard of comparison being needed, the best speed under the most favorable circumstances is required. The three principal methods proposed are: By a continuous run at sea, the speed being based upon the number of revolutions of the screw found necessary to give a knot in smooth water. By a similar run, the speed being based upon the number of revolutions of a measuring screw, rated in smooth water. By a continuous run at sea past a series of buoys or stations on shore, so arranged as to give the distance that the ship is likely to make, provision being made for accurate determination of the tide and current at frequent intervals along the course.

It is manifestly impracticable to obtain a course free from wind and current, and impossible to steer a vessel without allowing it to deviate from the straight line connecting the terminal points. The last method appears to be the favorite one at present; but each method has its objections, some of which are pointed out clearly in the papers above mentioned. Mr. Isherwood plainly states his doubts as to the accuracy of the measured mile trials, and yet he uses the results of some of these trials to throw doubt upon the method of revolutions of the screw. The paper above, translated by Mr. Leutzé, shows clearly the source of inaccuracy in those trials, and in place of taking the slip of the Boston's screws to discredit the method of revolutions of the screws, the irregular slip, even at such widely varying speeds, should have been sufficient to throw doubt on the distance traveled as determined by the observations. This translation of Mr. Leutzé's shows how the distance traveled should always be increased more or less to allow for inaccurate steering, and also that although the method of running backwards and forwards over the same course, when only short intervals of time elapse, will correct the error due to the component of the tide acting in the line of the vessel's keel, it ignores the other component which increases the distance both in going and in coming.

It would seem as if all of the three methods were correct theoretically, the practicable application of them being the great difficulty. The great objection to the last method proposed is the expense. Large signals must be erected and their positions carefully determined, the course must be well buoyed, and a number of vessels anchored at various points along the course so that the strength and set of both surface and sub-surface currents can be observed; then with a smooth sea and little wind the speed could be determined with a near approach to accuracy. There is one point that will always throw some doubt upon the results reached by running over a buoyed course, and that is the error produced by the current. No doubt, with a number of stations and numerous current meters, the strength of the current at various depths can be ascertained and its full effect upon the vessel be calculated; but the resultant direction will be always somewhat in doubt, particularly when it can only be approximately determined by the compass. This may be a small error, but when taken together with the necessary inaccurate steering of the vessel, the results will be further from the truth than if using the simple and less expensive method of taking the number of revolutions made by the screw in a given time.

The advantages of the measuring screw proposed by Mr. Isherwood are that the screw may be rated by means of a medium sized vessel, over a short course

at not above medium speeds. Once rated, the course may be set in any direction from the land, keeping in deep water and having the wind abeam. The actual distance over the bottom becomes of no importance; the current, therefore, does not affect the results, nor does the course steered, so long as the helm is not put over so as to retard the ship. In other words, if the measuring screw be properly rated, the exact number of revolutions in precisely four hours will give the required speed. If we can obtain the rate of the vessel's screw we have all the advantages of the measuring screw without the necessity of providing a special instrument, and then there must always be some doubt as to the rigidity of the measuring screw when used on vessels of high speed. There is one point about the vessel's screws: why rate them at low speeds, when only high speeds will be used? It is obvious that if anything happens to the machinery so as to cut down the speed beyond a very slight amount, the trial will be useless for purposes of comparison, and the contractors would certainly demand another trial. Therefore the screws need be rated only for the best speeds of the vessel and speeds slightly below the best. The vessel can be sent over the measured mile with good way on and with plenty of steam; the mean between two runs made at short intervals apart will eliminate the error made by one component of the current, and by carefully determining the terminal positions, not relying on the ranges alone, the error produced by the other component can be removed. Then by applying the corrections for deviation from course, the exact distance traversed can be obtained. A break-circuit chronometer would give exact time intervals, and an improved counter would record the number of revolutions. A few runs at each speed would suffice to rate the screw. It is possible that the change of load during the four hours' run would affect the slip, but as the high speeds are within the squatting limit, this does not seem probable, but it might be readily tested on the measured mile.

In spite of Mr. Isherwood's argument, the revolutions of the vessel's screws would still appear to be likely to give the nearest approach to accurate results. In fact, for one usually so accurate, Mr. Isherwood has been quite careless in his presentation of the facts. His mean of all the slips, in the case of the Boston, should have been 12.75, not 11.75 per cent, and this would have given a smaller variation between the experimental and the calculated speeds. Again, if he had not been trying to make his facts prove his case, he would hardly have been willing to assert that the mean slip, ascertained from widely varying speeds, could be the true slip, or that experiments made with unsatisfactory precautions were of use in proving his theory.

In all the methods proposed there are chances of error, in fact none are strictly accurate; but the one that will produce the most regular results, with the nearest approach to accuracy and the least expenditure of money and time, is the one proposed by the Engineer in Chief, if it be so modified as to leave out the lower speeds he proposed, and the contractor be required to run over the measured mile at the highest speed, and if no speed below 18 knots be used to determine the number of revolutions per mile. The distance through the water is what we want; we can ignore the current and avoid the effect of the wind, the number of revolutions and the elapsed time can be noted with precision, and the results must be accepted as a very close approximation to the truth.

R. W.

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## PROPOSED NAVAL MESSENGER PIGEON SERVICE.

Most of the European governments have now fully recognized the practical value of homing pigeons as messengers, and possess a complete system of pigeon stations along their respective coasts, under direct control of the government.

Canada has quite recently followed their example by establishing an organized system of messenger pigeon stations throughout the Dominion, extending from Halifax to Windsor and connecting her principal seaports with the interior.

We advocated in the Proceedings No. 47 (1888) and No. 48 (1889) the establishment of a similar system at our principal seaports of the Atlantic coast and on some men-of-war. So far, no organized service of messenger pigeons has been established in the United States Navy, but some interesting trials have been made at the United States Training Station at Newport. Commander T. J. Higginson, U. S. N., recently in command of the U. S. S. New Hampshire, says, in answer to an inquiry as to advisability of establishing a connected service of messenger-pigeon stations along the Atlantic coast: "In answer to your letter concerning carrier pigeons, I beg leave to state that I would favor a system of stations along the coast, with a central station for breeding, and I think Newport would be the best place for that purpose; breeding the birds here and transferring them while young to the other stations so that their first flight would return them to their permanent homes.

We have at this station erected a pigeon-house and have some choice messenger stock. Although our cote is still in its infancy, we have made some very interesting trials with our birds, and have been much pleased with some of the results. One of the pigeons flew from the Hen and Chicken's Lightship to our cote, a distance of twelve miles, in 16 minutes and 35 seconds. One of our birds has a famous record and is a sister to the famous homer Akron which won the international gold medal in 1887 for best speed. The brother of one of our flock flew from Washington to Fall River, a distance of 365 miles, in 11 hours and 7 minutes. The parents of several of the carrier pigeons belonging to this station have records of over 400 miles, and some of them are from imported pure Belgian breeds. Pedigree is the principal requisite in a homing bird.

Several of our birds were taken to New York on the Juniata last year, with intention of liberating them along the coast. The weather, however, was thick and they were not flown. While at Brooklyn one of the pigeons escaped from the Juniata and it was considered lost, as it had never flown a greater distance than from Point Judith, but great was our surprise when in a few days the bird arrived at his home here safely and in good condition.

I think it would be a good plan for all naval vessels leaving Newport to be supplied with carrier pigeons for the purpose of sending communications ashore and to train them for long distance flights. The use of carrier pigeons as bearers of dispatches would prove of great use to the naval service, and I am heartily in favor of establishing carrier pigeon lofts along the Atlantic coast. I have no doubt of the success of the undertaking if it were organized and thoroughly executed."

This is very encouraging and a strong indorsement in favor of establishing a naval messenger pigeon service. The use of homing pigeons in the merchant marine is quite common. It is a well known fact that many captains have pigeons on board for use in communicating with the vessel from the small boats away from it or from shore. These birds, it is said, never mistake any other vessel for their own when at dock or in the harbor. Among the numerous instances of the use of pigeons for sea service we mention that of a bird which, liberated from the steamer Waesland at one o'clock in the afternoon, when three hundred and fifteen miles from Sandy Hook, was at his loft in the evening. Another let go from the Circassia at nine in the morning, when two hundred and fifty-five miles out, brought a message in the afternoon. Major-General D. R. Cameron, Director of the Messenger Pigeon Association, Canada, says in his letter: "I am of opinion that a most important branch of the pigeon service will be connected with coast service. The evidence that these birds can be relied on to cross 400 miles of the ocean is apparently thoroughly reliable.

Amongst the many ways in which pigeons capable of doing so much might be used, not the least interesting to a large and very influential part of the public would be the conveyance of intelligence from the passenger vessels crossing the Atlantic. Reducing the belt within which vessels between Newfoundland and the coast of Ireland are beyond the reach of telegraph stations by 800 or 900 miles, would be a result of the highest importance." Another writer on the subject says: "It is a wonder to me, after these experiments, that the captain of any vessel should leave the shore without the means of communicating with it." Among recent experiments in France and Italy the official reports show that during the squadron manœuvres pigeons were freely used as messengers, and often arrived many days before the dispatch vessels sent at the same time.

A system of lofts to be situated at the principal navy yards along the Atlantic coast could be established at a very small expense to the government, as the homing pigeon fanciers throughout the country are anxious to see the government take hold of the matter and are willing to give their hearty support to the enterprise.

We suggest a connected system of twelve main naval lofts to be situated at the following navy yards and stations:

1. Portsmouth.
2. Boston.
3. Newport. Already established on receiving ship New Hampshire.
4. New London.
5. New York.
6. Philadelphia. Receiving ship St. Louis.
7. Washington. (Central Station.)
8. Annapolis. (On the Santee.)
9. Norfolk.
10. Port Royal.
11. Key West.
12. Pensacola.

The greatest distances being between the last four naval stations, some intermediate points would be needed between them to insure a connected service. Beaufort, N. C. (or Fort Macon), Wilmington, Georgetown, Charleston, Savannah, Jacksonville, Tampa, Cedar Keys, and Apalachicola, would be desirable "points de relâche." Several of these stations have already private lofts. Key West has a loft belonging to the Army Signal Service. From these lofts any vessel could be supplied with pigeons and cotes be built on board some men-of-war as in the French Navy.

*Advantages of an Organized Service of Messenger Pigeons.*

A service of messenger pigeons for naval purposes could not be improvised at short notice, and the birds would require long and careful training before being of any use as bearers of dispatches.* In war time the occasions are innumerable when serious derangement of plans, loss and discomfiture may be involved by the absence of previously organized provision for the rapid transmission of news. The advantage in favor of the side possessing such facilities over an opponent without them is enormous.

War vessels defending a coast are frequently without the means to transmit vital intelligence to the mainland. If provided with trained and reliable messenger pigeons they could send communications ashore over a distance of several hundred miles, signal the approach of the enemy's fleet and report his every movement.

In peace, vessels leaving and approaching the coast could report the position of disabled vessels needing assistance, and signal their own needs and locate wrecks. At places remote from telegraph stations, light-houses, camps and squadron manœuvres, interrupted electric communication and many other

*From the report of Major-General Cameron.

circumstances afford numerous occasions for employing homing pigeons as messengers.

The fact that homing pigeons can fly several hundred miles a day at sea, that birds can be bred and trained on board ship, that they can be accustomed to the noise of the guns, that they can recognize their own ship among others, that they can be relied upon, as proved by numerous experiments, to carry news from the fleet to the shore (and under favorable circumstances from the shore to the fleet and from one vessel to another), when beyond the range of heliograph and electrograph, should suffice to secure the support of the government to this new enterprise, and encourage the speedy establishment of a permanent system of naval messenger pigeon lofts at the principal navy yards and stations along the Atlantic coast.

H. MARION,
*Assistant Professor, U. S. Naval Academy.*

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## THE TIME AND DISTANCE REQUIRED TO BRING A SHIP TO A FULL STOP AFTER THE ENGINES ARE STOPPED AND REVERSED.

BY ASSISTANT NAVAL CONSTRUCTOR WILLIAM J. BAXTER, U. S. N.

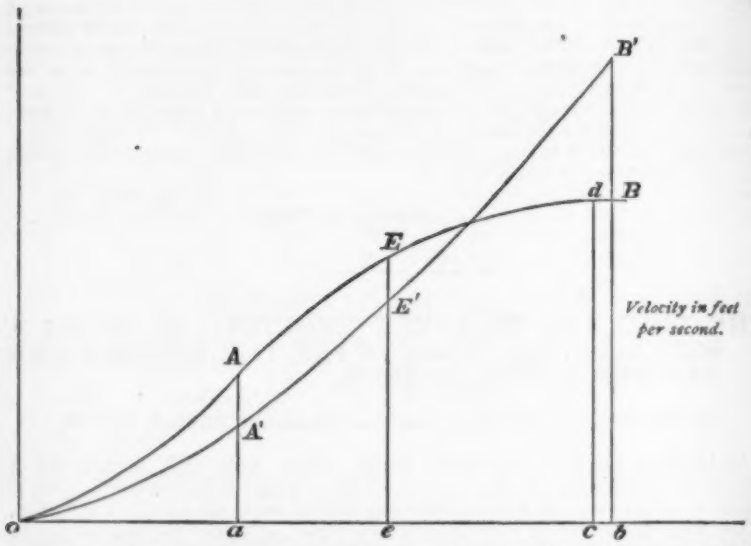
In handling ships in a crowded harbor during fleet drill, in avoiding a friend, or in ramming an enemy, it is of the highest importance for a naval officer to know the time and distance required to bring the ship to a full stop, when moving at varying speeds, after the order has been given to stop and reverse the engines. The captains of merchant steamers, from their constant practice, would be expected to estimate with more accuracy than naval officers, whose opportunities for knowing their ships are much more limited; but the results of investigations by the Office of Naval Intelligence (General Information Series No. VIII) show that even with these merchant captains the tendency to underestimate both the time and the distance is somewhat general.

It would doubtless be a great convenience if every ship carried the means of accurately determining the time and distance required for these manœuvres, so simply arranged as to be ready for instant use by an officer totally unacquainted with the ship. To determine this data accurately for each ship would require an elaborate series of experiments; but, by the methods suggested below, it can be obtained and put in a shape for ready reference, with but little inconvenience and a small amount of calculation, with so close an approximation to theoretical accuracy as to fulfil all practical requirements.

The following is the principle of the method:

Suppose the curve $OAEB$ to have been constructed, having times, in seconds, as abscissae, and velocities in feet per second as ordinates; at any point $B$ the velocity in feet per second is represented by $Bb$, and the time in seconds that will elapse from zero velocity is represented by $Ob = T$; if $cb$ represent a unit of time, the distance passed over in this time, $dt$, will be represented by $vdt = cb \times cd =$ area $cdBb$, and as the same is true of any point in the curve, the whole distance passed over will be represented by $\int_0^T vdt =$ total area of the curve $OAEBb$. The same is true of other points on the curve; thus, the area $OAa$ represents the distance that would be passed over before the velocity is reduced to zero, and $Oa$ represents the corresponding time. These areas can be taken as the ordinates of a new curve; thus, to any convenient scale, $A'a$ represents the area $OAa$, $B'b$ represents the area

*OAEBb*, so that for any velocity represented by *Ee*, *E'e* represents the distance and *Oe* the time. If, then, a set of these curves is provided for a ship,




by an instant's inspection, an officer, knowing the ship's velocity, can tell the distance and time required for her velocity to be reduced to zero and the ship come to a full stop.

To find the data necessary for constructing these curves two methods are suggested.

### First Method.

Let the ship steam at her highest possible speed, having one officer detailed for observing the speeds, and another for observing the corresponding times. At a given signal, whose time is noted, let the order be given to stop and reverse the engines, and as the ship loses speed the observers note the speeds and the corresponding times, continuing these observations as rapidly as possible until the ship comes to rest, and have the data entered on a form, as follows:

U. S. S. Ohio.—*February* 16, 1890.

| Knots per hour reduced to feet per second. | Speeds in knots. | Times observed. | Elapsed time in seconds. | Direction and force of wind. | Condition of sea. |
|---|---|---|---|---|---|
| 20—31.80 10—15.90..... | 16 | 10 48 0 | 243 | Three points abaft the beam; Force, 3. | Slight swell. |
| 19—30.20 9—14.31..... | 14 | | | | |
| 18—28.62 8—12.72..... | 12 | 49 18 | 165 | | |
| 17—27.03 7—11.13..... | 10 | | | | |
| 16—25.44 6— 9.54..... | 8 | 50 02 | 121 | | |
| 15—23.85 5— 7.95..... | 6 | 50 27 | 96 | | |
| 14—22.26 4— 6.36..... | 4 | 50 56 | 67 | | |
| 13—20.67 3— 4.77..... | 2 | | | | |
| 12—19.08 2— 3.18..... | 0 | 52 03 | 0 | | |
| 11—17.49 1— 1.59..... | | | | | |

To draw the curves, use zero velocity and the time corresponding for the origin of co-ordinates; convenient scales are: 1 inch equals 10 seconds, and ½ inch equals 10 feet per second. To plot a point on the curve, say that corresponding to 8 knots, from the above table, the ordinate 12.72 is found in column 1, and the abscissa 121 in column 4; other spots are plotted in the same way, and a fair curve is drawn through them. As all subsequent results depend for their accuracy on the accuracy of this curve, it should be checked by an acceleration curve.

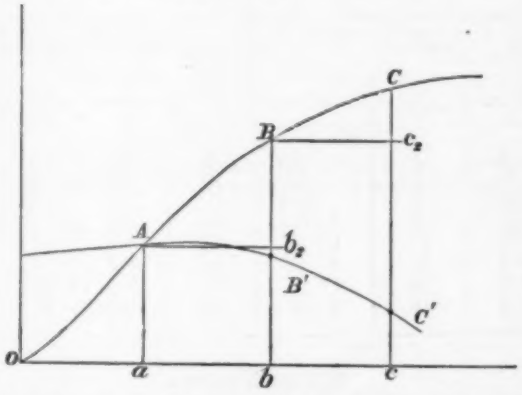
To construct this curve, let $OABC$ be a time-velocity curve, $Oa$, $ab$, $bc$ being units of time, since the acceleration

$$= \frac{dv}{dr},$$

$$\frac{dv_1}{dr} = \frac{Aa}{Oa} = \frac{Aa}{1},$$

$$\frac{dv_2}{dr} = \frac{Bb_2}{Ab_2} = \frac{Bb_2}{ab} = Bb_2 = B'b,$$

$$\frac{dv_3}{dr} = \frac{Cc_2}{Bc_2} = \frac{Cc_2}{bc} = Cc_2 = C'c,$$




and a curve of acceleration can be drawn having $Aa = Aa$, $B'b = Bb_2$, $C'c = Cc_2$, etc., as ordinates, showing the acceleration at any time and velocity. The relation Force — Resistance = Mass × Acceleration is a fundamental one, and it is readily seen that when the ship is moving ahead at uniform velocity the acceleration vanishes and Force = Resistance, but after the engines are stopped and reversed this becomes — Force — Resistance = Mass × Acceleration, or Force + Resistance = Mass × — Acceleration. This negative acceleration is composed of two parts, that due to the resistance offered by the water to the onward motion of the ship, and which varies with a varying power of the speed, and will thus quite disappear when the ship comes to a full stop; the other part is that due to the force of the engines acting through the propeller and pulling the ship astern. A few seconds will elapse after the signal is given before the engines can be reversed, and after reversal before they are acting efficiently, but after this time their force is practically constant, and a constant acceleration is produced. It should be noted, however, that these accelerations cannot be exactly evaluated, because "Mass" in the equation consists not only of the known mass of the ship, but also the mass of the water which is drawn after the ship, the value of which is unknown.

The acceleration curve, as used as a check on the velocity curve, must be a fair curve, must be nearly parallel to the axis of abscissae near the origin, and contain no re-entrant curves. If it does not fulfil these conditions there are personal errors or errors of observation in the velocity curve, and the latter must be altered until it and its acceleration curve are fair curves.

Having thus obtained an accurate velocity curve, its integral or curve of areas must be found, and this can be done accurately enough by using the trapezoidal rule with an interval of about one-tenth the total time; thus, from full speed to full stop, 250 seconds later, the distance is

$$25\left(\frac{25.4}{2}+25.1+23.6+20.5+16.8+13.2+10.0+7.2+4.6+2.2\right)$$

$$=3397.5 \text{ feet}=1132.5 \text{ yards.}$$

Performing the same operation at each interval the distances are found and plotted to convenient scales, and a fair curve drawn as in the accompanying diagram.

To use this diagram it is only necessary to know the speed at which the ship is moving, and the corresponding distance and time are readily found, and a table similar to the following can be made for ready reference.

| Speed knots. | Distance and time required to bring ship to a full stop after engines are stopped and reversed. | | | Speed knots. | Distance and time required to bring ship to a full stop after engines are stopped and reversed. | | |
|---|---|---|---|---|---|---|---|
| | Yards. | Ship-lengths. | Time. | | Yards. | Ship-lengths. | Time. |
| | | | Min. Sec. | | | | Min. Sec. |
| 1 | 14 | $\frac{1}{2}$ | $18\frac{1}{2}$ | 9 | 255 | $3\frac{1}{2}$ | 2 $12\frac{1}{2}$ |
| 2 | 27 | $\frac{1}{2}$ | $35\frac{1}{2}$ | 10 | 318 | 4 | 2 $22\frac{1}{2}$ |
| 3 | 42 | $\frac{1}{2}$ | $52\frac{1}{2}$ | 11 | 390 | $4\frac{1}{2}$ | 2 34 |
| 4 | 59 | $\frac{1}{2}$ | 1 $07\frac{1}{2}$ | 12 | 465 | $5\frac{1}{2}$ | 2 45 |
| 5 | 80 | 1 | 1 22 | 13 | 548 | $6\frac{1}{2}$ | 2 56 |
| 6 | 108 | $1\frac{1}{2}$ | 1 36 | 14 | 658 | $8\frac{1}{2}$ | 3 11 |
| 7 | 147 | $1\frac{1}{2}$ | 1 49 | 15 | 816 | $10\frac{1}{2}$ | 3 30 |
| 8 | 195 | $2\frac{1}{2}$ | 2 01 | 16 | 1095 | $13\frac{1}{2}$ | 4 03 |

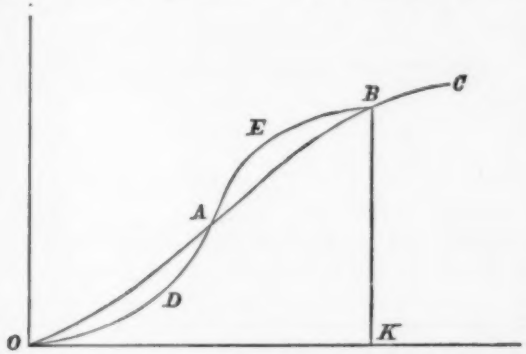
### Second Method.

At convenient opportunities, when the ship's speeds are different, let the signal be given to stop and reverse the engines, noting the time required to bring the ship to a full stop, after the signal is given, recording the data, thus:

| Date. | Speed of ship before signalling to stop and reverse. | Time required to bring ship to a full stop. | State of Sea. | Remarks. |
|---|---|---|---|---|
| January 3, 1890.... | 14 knots. | 192 | Smooth. | 3 boilers. |
| December 17, 1889. | 10 " | 143 | Smooth. | 2 " |
| February 2, 1890... | 2 " | 35 | Moderate swell. | 2 " |

The velocity curve can then be plotted from its co-ordinates in columns 2 and 3, and the acceleration and distance curves drawn as in the first method.

In addition to the error due to neglecting the mass of the following water, there is another error due to the assumption that one velocity curve can be made to satisfy all the requirements; thus, let *OABC* be the velocity curve at




15 knots, and *ODAEB* that at 14 knots, then these methods assume that the area *ODA* = area *AEB*, *i. e.* area *OABK* = area *ODAEBK*, the latter is a little greater, so that ships will slightly overrun the distances as given by these methods. If a complete series of experiments could be carried out on one ship, the probable rate of error could be determined and so tabulated that when applied to the results obtained by these methods, practical accuracy would be obtained.

The data and diagrams described, however, will furnish the necessary information so accurately as to be of great service to officers; and when used in connection with the tactical diameters, precision in fleet manœuvres can be more easily secured.

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## THE ENGINEER.

FEBRUARY 15. Overheated boiler plates.

An abstract of a series of experiments made by M. Hirsch to determine the effect of rapid evaporation on fast steaming boilers.

Racing of marine engines.

MARCH 1. Roberts water-tube boilers. Lift of safety valves. Boiler design. Facts about aluminum.

MARCH 15. Corrosion of propeller shafts. Cylinder lubrication. Electric welding.

APRIL 12. The use and abuse of forced draught. J. K. B.

JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES.

VOLUME IX, No. 2. Some tests and observations on building stones. Notes on the harbor facilities of Cleveland for handling coal and ore. Some points on bridge inspection. J. K. B.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

The Marshall valve gear. Tests of Worthington pumping engines. Turkish torpedo-boats.

A description with illustration of the hull and machinery of the torpedo-boats built by the Germania Co., of Berlin and Kiel, for the Turkish Government. On the trial trips these boats repeatedly reached 21.8 knots with an extra weight of 6 tons coal on board. On the three hours' run at sea an average speed of 21.3 knots was obtained.

The second trial of the U. S. S. Baltimore.

After the first trial of this vessel some changes were made in the machinery, the most important being the increase of the pitch of the propeller to about 21.5 feet and an overhauling of the main valves to secure a freer exhaust area, a later cut-off in H. P. cylinders and an overhauling of the air pumps. On the trial a reserve supply of fresh water was carried in the double bottom to make up for losses and to avoid danger due to foaming from a mixture of salt and fresh water. The indicated horse-power for all the machinery (maximum) was 10725.60. The maximum speed obtained was 20.6 knots, and the H. P. developed 9568.47. From an examination of the data in the two trials, the increase in horse-power in the second trial was due to higher steam pressure, greater air pressure and the use of the two auxiliary boilers, coupled with the better use of the steam due to freer passages. As a result of the second trial the contractors receive a premium of $106,442 for excess of power developed.

A description of the hull and machinery of the torpedo-boat Cushing. J. K. B.

MECHANICS.

FEBRUARY, 1890. Steam boiler design. Air supply to boiler furnaces. Sprague electric locomotive for metal mines and freight tramways. Steam jackets.

A paper by Prof. Dwelshauvers-Derry of Liege, on the mode of action of steam jackets, with experimental data showing the reasons of their economy.

Shaking grates on the Pennsylvania R. R.

A description of the Reagan grate, with the results of a successful experimental test of a continuous run for a week.

MARCH. The properties of aluminum, with some information relating to the metal.

A reprint of a paper read before the American Institute of Mining Engineers, in which the properties of the metal are very fully discussed under the headings of: Purity of aluminum, its properties with reference to specific

gravity; the action of heat; corrodability; its mechanical properties; conductivity; the action of impurities; the alloys of aluminum; methods of analysis; methods of preparation of aluminum, and practical hints on the subject of the treatment of the metal.

Aluminum bronze and brass as a suitable material for propellers.

An article by E. H. Cowles, descriptive of the various metals that have been used for screw propellers, a comparison of aluminum bronze with the alloys now used, the advantages claimed, and to which are added tables of compositions and tests.

Electrical accumulators or storage batteries.

APRIL. Steam boiler design. The elements of gropostatics. Theory of chimney draught. A steam-tube cleaner. J. K. B.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

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## THE RAILROAD AND ENGINEERING JOURNAL.

FEBRUARY, 1890. Counterbalancing the revolving and reciprocating parts of locomotives. Radial valve gears.

A paper read before the Hull Institute of Engineers and Naval Architects, by J. R. Smith, containing a description with sketches of the varied forms of radial gear, from the earlier inventions of Hackworth up to the modern adaptations of Jay, Marshall and Morton, with a discussion on the relative merits claimed for each type.

### Water-tube boilers.

An abstract of a paper read before the Institution of Civil Engineers by W. I. Thorneycroft. The author commenced by discussing the kinds of circulation in various forms of tubulous boilers, arriving at the conclusion that circulation in order to be perfect must be systematic. By circulation was meant the motion of water contained in a generator from the upper surface of the liquid down to the lowest part, and returning again to the upper surface, in contradistinction to the motion of water simply from the point where feed enters to a point in the boiler where it becomes steam. Having defined this

term, all boilers were divided into classes depending on the method of circulation. The boilers of Perkins, Herreshoff, Temple and Field were compared and discussed. The failure of the boilers of the Propontis was attributed to the fact that the upper ends of the tubes were of such large diameter that instead of steam and water passing over in foam, steam alone left the tubes, and all impurities brought in with the feed gradually accumulated on the upper part of the tubes and ultimately led to their destruction. The lightness of structure and strength to resist internal pressure were next mentioned, and the advantage of the tubulous boiler in this respect fully discussed. The paper concluded with the results of some recent trials by Professor Kennedy on boilers sent out by the author's firm, both under natural and forced draught, with a full description of the method of working. At the most economical rate the evaporation reduced to standard amounted to 13.4 pounds water per pound of fuel, and the following heat table showed the way the heat of combustion was utilized:

| | | |
|---|---|---|
| Heat expended in heating and evaporating feed water | 86.8 | per cent. |
| " " " raising temperature of furnace gases | 10.8 | " |
| " lost through formation of carbonic oxide | 0.5 | " |
| " " by radiation and otherwise unaccounted for | 1.9 | " |
| | 100.0 | " |

The high percentage of evaporation represented the efficiency of the boiler, and was simply equal to the ratio between actual evaporation and that theoretically due to perfect combustion, or 13.4 : 15.4.

Torpedo-boats for the Italian navy. United States naval progress.

Recent circulars from the Navy Department on the construction of machinery and hull of new vessels. Progress in ordnance and armor plates. Notice of competitive trial of armor plates to be held at the Proving Ground.

APRIL. Grüson's quick-fire guns. Boilers with corrugated fireboxes. The English armored cruiser Impérieuse. United States naval progress.

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Interoceanic communication by way of the American isthmus.

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The form of crater produced by exploding gunpowder in a homogeneous solid. Notes on fuel-gas. Notes on some coals in Western Canada. Concentration of low grade ores. The Davis-Colby ore-roaster. Electrical accumulators or storage batteries. The peculiar working of a blast furnace. Natural gas explorations in Eastern Ontario. J. K. B.

## REVISTA DE LA UNION MILITAR, BUENOS AYRES.

MARCH, 1890. Railways, with regard to their military importance. Our military situation. Foreign notes and reviews. J. B. B.

REVUE MARITIME ET COLONIALE.

JANUARY, 1890. The scientific mission to Cape Horn (continued). The earth magnetism. Meteorologic periods. A study of the preparations and plan of operations against Sontag (Tonquin). The main features of the organization of the coast defenses of Germany. Oceanography: Topography of the sea, etc. (continued). Naval chronicles.

FEBRUARY. Reports of the prize essays of 1889 at the Academy of Sciences. A history of a fleet of the past. Maritime chronicles of Antwerp, 1804–14. Oceanography: Statics (continued). Naval chronicles: The Gibraltar station; New regulations for firing salutes, etc.

MARCH. Oceanography: Statics (continued). A history of a fleet of the past (continued). Notes on the diurnal variations in the direction of the trade winds. Movements of the atmosphere. Naval chronicles; The Channel squadron; The armored ship Victoria and her guns; The armored Trafalgar, etc. J. L.

REVUE DU CERCLE MILITAIRE.

JANUARY 12, 1890. A German criticism of the French army. Strategic army transportations. Cavalry and the smokeless powder.

JANUARY 19. The soldier's hygiene.

JANUARY 26. A proposed manual of field artillery fire. Supplying ammunition to artillery in the field.

FEBRUARY 2. Night marches and attacks. Infantry advanced posts.

FEBRUARY 9. Supplying ammunition to artillery in the field (continued). Night marches and attacks (continued).

FEBRUARY 16. Renewing the supply of artillery in the field (continued). Night marches and attacks (ended).

MARCH 2. Getting field artillery ready for war. Espionage in war.

MARCH 9. The German navy. New fire regulations in the Russian army.

MARCH 16. Movable strategic bridges.

MARCH 23 and 30, and APRIL 6. Getting field artillery ready for war (continued). The German rifle, model of 1888. The Italian army mobilization. J. L.

RIVISTA MARITTIMA.

JANUARY, 1890. Steamships and steamship lines—an historical and descriptive sketch, by Salvatore Raineri. A military study on the defense of the maritime frontier, by G. G. New French war ships, by D. G. The compass in modern war vessels (transcription of Proceedings of Royal United Service Inst.). Study on coast-defense tactics (from the same). Description of H. M. S. Blake.

FEBRUARY. Steamships and steamship lines (continued). The Institute of Electrical Technology, by G. Bertolini. The economy of steam navigation. Study on coast-defense tactics (continued).

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RIVISTA DI ARTIGLIERIA E GENIO.

JANUARY, 1890. Repeating arms (with plates), by Lieutenant-Colonel Viglezzi. The difficulties in concentrating fire of field batteries, and how to overcome them, by Captain Leser. Notes: On field shrapnels; Russian 6-inch field mortar; Double-acting fuze for same; New electrical apparatus for exploding mines.

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MARCH. Variations of trajectory in elevated regions. The Austro-Hungarian artillery. Russian field operations. Notes: The new Austrian rifle; Experiments with Nobel's smokeless powder; On firing against balloons; Artillery *vs.* cavalry. J. B. B.

REVISTA MARITIMA BRAZILEIRA.

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REVISTA MILITAR DE CHILE.

JANUARY, 1890. Armstrong rapid-fire guns, by Don J. C. Salvo. Instructions for target firing (small arms). First assistance to the wounded on the field of battle (trans.). Transportable turrets for field fortification (trans.).

FEBRUARY. Necessity for compulsory military service. Comparative weights of infantry equipments of different nations. Instructions for target firing (continued). First assistance to the wounded on the field of battle (continued).

MARCH. Modern artillery. Battle formations. Instructions for target firing (continued). J. B. B.

SCHOOL OF MINES QUARTERLY.

Irrigation engineering. Patent equivalents. Indian grass oils.

THE STEAMSHIP.

FEBRUARY, 1890. On the stresses produced in circular metal plates by unequal temperature. Curves of statical stability. High-speed engines for cargo boats.

MARCH. Supplementary note on Bremme's valve gear. Radial valve gears.

APRIL. Notes on the application of speed formulæ. On the loss by condensation and re-evaporation in steam cylinders. Protection of propeller shafts. Boiler furnaces.

A paper read before the N. E. Coast Institution for the purpose of eliciting opinions and discussion on the advisability of further increasing the thickness of furnace flues.

Friction of screw propeller engines.

A paper read before the Institute of Marine Engineers, and dealing with the losses due to friction on the various parts of the marine engine, from the pistons to the propeller blades; the question of rough surfaces and lubricants; the form of steam valves; the different kinds of metal used in bearing bushes, and the materials used for propeller blades.

The increase in the British navy. J. K. B.

THE STEVENS INDICATOR.

VOLUME VII, No. 1. The transmission of power by wire rope. On the most economical engine for small power. Testing machines. Notes on Rankine's treatment of chimney draught. Design for a hot-air heating apparatus. Stevens Institute course in experimental mechanics. J. K. B.

TRANSACTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

NOVEMBER, 1889. Experiments relating to the hydraulics of fire streams.

An investigation in detail of the scientific principles governing the customary means of delivering water for extinguishing fires. The experiments described, in completeness and accuracy, are about the most reliable yet undertaken. The subjects investigated were: the coefficients of discharge of nozzles of various forms, loss of pressure by friction in fire hose, effects of curves in line of hose upon loss of pressure, effect of reduction of area at coupling, heights and distance reached by jets of water under various pressures, influence of size of jet upon height attained with a given pressure, and efficiency of different kinds of nozzles. J. K. B.

TRANSACTIONS OF THE NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.

JANUARY, 1890. Coal mining at Warbora, East Indies. J. K. B.

INSTITUTION OF MECHANICAL ENGINEERS.

1889, No. 3. Description of the Eiffel tower. The ether-pressure theory of thermo-dynamics applied to steam. The rationaliza-

tion of Regnault's experiments on steam. On gas engines, with a description of the simpler engines. J. K. B.

UNITED SERVICES GAZETTE.

FEBRUARY 8, 1890. Range-finding; its destined effect on tactics. Modern military rifles and how to use them.

FEBRUARY 15. The ship's chronometer; its history and development. The Barracouta explosion. The future American navy.

FEBRUARY 22. Lessons to be learnt from naval manœuvres. The defense of ports and coaling stations. Coast defense. The health of the navy. The naval uniform question. Malta harbors.

MARCH 1. Lessons to be learnt from the naval manœuvres. Gunnery trials of the Trafalgar. Naval medical service. The health of the navy.

MARCH 8. The Royal United Service Institution. Exit masts, yards and sails. The health of the navy—III.

MARCH 15. The navy estimates. Lessons from the naval manœuvres. Sea chests. Naval amenities.

MARCH 22. The navy estimates. Report of the Army and Navy Commission. The Coast Guard. The navy estimates.

MARCH 29. Institution of Naval Architects. The navy estimates. The administration of the services. Naval amenities—II.

APRIL 5. The navy estimates—IV. The administration of the services. Great guns. Weight of machinery.

APRIL 12. Arrival of the Calliope. Naval notes. Naval amenities.

APRIL 19. Notes on recent naval manœuvres. Bray's Gunnery Instructor. The Barracouta disaster.

APRIL 26. Notes on the defense of a modern fortress. Messenger swallows. Naval amenities—IV.

MAY 3. The Duke of Edinburgh and the missions to seamen. Naval manœuvres at Hong Kong. The Coast Guard. The defense of Australia—I.

MAY 10. Salve Calliope!—an epic of March 16, 1889. Engineer Corps of the United States navy. The defense of Australia—II. The Coast Guard. Sight tests for volunteers. Actuarial calculations.

MAY 17. Gun trials of the Howe. Stern-wheel gunboats for the Zambesi. The Coast Guard. War cruisers.

MAY 24. Forced draught. R. W.

LE YACHT.

JANUARY 11. Editorial on the promotion of lieutenants by selections for 1890. The trial of Le Gymnote. The use of life-buoys. The increase in the British navy for 1889–90.

JANUARY 18. Editorial on the Newfoundland and Miquelon

fisheries. The use of life-buoys. The International Marine Conference.

JANUARY 25. Editorial on the large battle-ships. Notes from foreign ship-yards. Review of the merchant marine. Description and cut of the cruiser Le Hoche.

FEBRUARY 1. The International Marine Conference. First-class Yarrow torpedo-boats; cut of the disposition of the ejecting tubes. Review of the merchant marine.

FEBRUARY 8. New vessels appropriated for. Budget of 1891. Rules of the road proposed by the International Marine Conference. Notes from foreign ship-yards. Review of the merchant marine.

FEBRUARY 15. Editorial on the proposed increase of the United States navy. Description and plans of a petroleum torpedo-boat. Notes from foreign ship-yards. Review of the merchant marine.

FEBRUARY 22. Description of the twin-screw steamer Normannia of the Hamburg-American line. The accident in the fire-room of the Barracouta during her trial trip.

MARCH 1. Editorial on deep sea navigation for men-of-war as a school of instruction for officers and men. The use of flying squadrons. The necessity for "station navies" in the colonies. Article on the proposed transfer of the Bureau of Ordnance to the Torpedo Bureau. Review of the merchant marine. Cat-boats of the United States. Notes from foreign ship-yards.

MARCH 8. Editorial on smokeless powder. Description and plan of the San Francisco. The Italian torpedo-ram Fieramosca; description and cut.

MARCH 15. Proof firing of the Trafalgar's guns ; cut of the ship and arrangements of the rapid-firing guns. Review of the merchant marine.

MARCH 22. Editorial on the naval appropriation for 1890–91. Cruisers of Great Britain for the Australian squadron. Review of the merchant marine. Notes from foreign ship-yards.

MARCH 29. Editorial on the appropriations for the British navy for 1890–91. New vessels, types, etc. Notes from foreign ship-yards. Sketch of the Italian torpedo-boat Aguila.

APRIL 1. Editorial on battle-ships. Review of the merchant marine. The accident to the City of Paris. A. C. B.

# *SPECIAL NOTICE.*

## NAVAL INSTITUTE PRIZE ESSAY, 1891.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the Prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1891. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

5. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

6. All essays submitted must be either type-written or copied in a clear and legible hand.

7. The successful competitor will be made a Life Member of the Institute.

8. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of Board of Control.

RICHARD WAINWRIGHT,
*Lieut., U. S. N., Secretary and Treasurer.*

ANNAPOLIS, MD., *February* 20, 1890.